THURSDAY, SEPTEMBER 20, 1906

A TEXT-BOOK OF OPTICS.

Physical Optics. By R. W. Wood. Pp. xiii+546. (London: Macmillan and Co., Ltd., 1906.) Price 15*s.* net.

WHEN a book on optics by Prof. Wood was announced, students expected something interesting, and they have not been disappointed. In his preface the author explains that when he commenced his work Preston's "Theory of Light" was the only advanced English text-book of modern date available. Since that time Schuster's "Theory of Optics" and the English translation of the late Prof. Drude's "Lehrbuch der Optik" have appeared, and Prof. Wood had to consider whether they covered the field sufficiently.

His readers have cause to be glad that he answered this inquiry in the negative, nor will they regret the fact that he has laid special stress on the experimental side of the question, and has devoted considerable space to the account of some of his own work. His apologies for this are unnecessary; many of the experiments so described are beautiful, and students learn more from reading a man's account of his own work than in other ways.

While the book hardly claims, perhaps, to be a complete treatise, it covers a great deal of ground, and in particular deals with a number of matters, such as the laws of radiation, dispersion, fluorescence, and the optics of moving media, which are not so fully treated in some other recent works. A student commencing the study of optics would perhaps hardly begin with this book; he would find, however, in its pages when he came to read them some most instructive views of the subject. The earlier chapters deal with the rectilinear propagation of light and its reflection and refraction. They gain much by the photographic reproductions showing the passage of a wave of sound through an aperture, and after reflection and refraction at a plane surface, and teachers will do well to insist on the utility of the graphic method of studying the changes in wave form, which Prof. Wood uses freely.

The theoretical treatment of the matter is perhaps less satisfactory; it is based essentially on that of Verdet. Schuster's paper on the method of analysing in an elementary manner the propagation of a plane wave might with advantage have been alluded to. In dealing with both reflection and refraction, Fermat's law of minimum time is explained at an early stage, and afterwards freely utilised.

A special point in these early chapters is made of the refraction of light by media of varying density, and the results are used to illustrate and explain the phenomena of mirage. Prof. Wood's arrangement for producing mirage on the lecture table is well worth notice; so too are the experiments on anomalous dispersion, and especially the very beautiful one for showing the anomalous dispersion of sodium vapour.

We come next to the interference of light. The usual elementary account of the phenomena shown by Fresnel's mirrors and by the biprism is given, but it is supplemented with a simple description of how to make a pair of very satisfactory mirrors from a piece of modern mirror glass, or a biprism from some slips of glass and Canada balsam, and we are told that "a prism made in this way works quite as well as those supplied by opticians."

After a reference to the phenomena of light beats and achromatic fringes we pass on to the colours of thin plates and Newton's rings. The section on the polarised fringes produced by two streams polarised at right angles is very interesting, so too is that on the preparation of films for the exhibition of Newton's colours.

Diffraction is treated at first in an elementary way, then by means of Cornu's spiral, and finally, for a few simple cases, by means of calculation; the sections on the grating may be specially commended. In chapter viii. we find an able discussion of the modern interference spectroscopes, and here again, both in the case of the Michelson interferometer and of the echelon grating, the experimental conditions for successful working are carefully discussed. The interferometers of Fabry and Perot, and also of Lummer and Gehrke, are also described. The chapter on double refraction proceeds on ordinary lines. Stokes's verification of Huyghens's law might with advantage have replaced that due to Malus, which cannot give results of great accuracy. In chapter xii., the theory of reflection and refraction, the reader is introduced to Maxwell's equations of the electromagnetic field, which henceforth become his main guide in the theoretical part of the book, though the theory of dispersion is in the first instance developed on the lines of the work of Sellmeirr and Helmholtz.

With regard to optical theories generally, Prof. Wood has from the first adopted the view put forward by Schuster in the preface to his recent book on optics.

> "So long as the character of the displacements which constitute the waves remains undefined we cannot pretend to have established a theory of light."

In dealing with the theory of reflection and refraction, the importance of the part played by surface films is duly noted. From this point onwards the interest of the book becomes greatly increased. An admirable account is given of recent work, much of it due to the author, connected with dispersion and absorption, especially the anomalous dispersion of sodium vapour. The optical properties of metals are developed on the electromagnetic theory, and reference is made to the important work by Rubens and Hagen, who showed that many of the discrepancies between theory and experiment noted by other observers arose from the employment of waves of too short length in the investigation.

After some account of rotatory polarisation, we come to the chapter on magneto-optics. The theory is worked out according to the two lines indicated by Drude; the first hypothesis is based on the existence

of molecular currents in the median streams of revolving electrons the motions of which are acted upon by, and react upon, the magnetic forces of the impressed field, while the second hypothesis is that of the Hall effect, in consequence of which an electron thrown into vibration in a magnetic field experiences a force depending on its own velocity and on the strength of the field. The results of the theory are applied to the discussion of the magneto-optics of sodium vapour, taken from a paper by Prof. Wood himself, and also to an explanation of the Zeeman effect.

Chapters on the laws of radiation, the scattering of light, the nature of white light, and the relative motion of ether and matter conclude the book. In connection with this last subject, Prof. Wood points out that all experimental evidence, with the exception of the well-known Michelson-Morley experiment, is in favour of the hypothesis of a stagnant ether, and that the only explanation of this discrepancy, so far as we can see at present, is that due to Fitzgerald and to Lorentz, that a change is produced in the linear dimensions of matter by its motion through the ether.

Sufficient perhaps has been written to show that Prof. Wood has placed students under a considerable debt by the publication of this book, while the publishers are to be congratulated on the manner in which they have produced it.

RESEARCHES IN JAPANESE WATERS.

Ostasienfahrt: Erlebnisse und Beobachtungen eines Naturforschers in China, Japan, und Ceylon. By Dr. Franz Doflein. Pp. xiii+511. (Leipzig: Teubner, 1906.) Price 13 marks.

DR. DOFLEIN adds one more to the long list of books which have been written to give popular accounts of scientific expeditions. In the year 1904 he undertook a journey to the Far East for zoological purposes, and particularly with the object of investigating the fauna of Japanese waters, which is of peculiar interest, not only as possessing remarkable forms of its own, but as containing an admixture of genera belonging respectively to the cold northern seas and to the Indo-Pacific region, which meet in that locality, with a large "deep-sea" element. In the book before us we have a record of the observations and results of this voyage, and of the impressions made on the traveller by the countries he passed through.

The outward passage was an eventful one. In the Red Sea the *Prinz Heinrich*, on which Dr. Doflein had left Naples, was stopped and searched by the notorious Russian auxiliary cruiser *Smolensk*, and the mails were taken from her. The incident was made more exciting by the presence on board of high Chinese and Japanese officials, and created considerable commotion in Europe at the time. Further trouble, however, awaited the *Prinz Heinrich*. Off Dondra Head, in a heavy sea which would probably have sunk her boats if they had been launched, she struck some unseen object, sprang a leak, and only reached Galle Harbour just in time to escape sinking. Her passengers were then transferred to the *Polynesien*, on which they continued their voyage from Colombo, and arrived, after a further mishap in the shape of a breakdown of the engines, at Saigon. From this town, with the beauty of which Dr. Doflein was more struck than with its morals, he travelled by Hong Kong, Macao, Canton, and Shanghai, where he heard of the defeat of the Russian fleet and saw the interned *Askold* in dock, to Nagasaki, and thence by Yokohama and Tokio to Sendai Bay, in the Rikuzen district on the east coast, where his work was to begin.

The reason which had led Dr. Doflein to choose this locality for his investigations was that on the east coast of Japan the warm current known as the Kuro Siwo, or Japan coast current, derived from the north equatorial drift, meets the cold Kurile current from the north on more or less equal terms, and that therefore in this region the relations of the Indo-Pacific and northern faunas might best be studied. On the western side of the islands the Tsushima current, an offshoot of the Kuro Siwo, appears to have little influence on the temperature of the water, which, so far as is known, has here a more predominantly subarctic fauna. The result of the investigations at Sendai was to show that there is no sharp boundary between the southern and northern faunas, and there is evidence that the change from the one to the other is gradual, and takes place all along the east coast of Japan. This is probably due to the fact that the two currents interlace in a complicated manner and change their position with the time of year. Our knowledge of these currents is largely owing to the work of the unfortunate Admiral Makaroff, who perished off Port Arthur. Dr. Doflein's stay in Sendai was brought to an end by bad weather, and he then left for Sagami Bay in the south, where he made his headquarters at Aburatsubo in a small marine laboratory belonging to the University of Tokio.

The fauna of Sagami Bay is extraordinarily rich, probably on account of the abundant food supply owing to the mortality among the surface organisms of the two currents in consequence of the change of temperature when they meet. It has been collected by many naturalists from von Siebold onwards, and Dr. Doflein wisely gave his chief attention not so much to collection as to the observation of the habits and mutual interdependence of the animals, both of the deep and shallow waters. He describes his impressions of the latter in a graphic chapter, and makes some interesting remarks on the meaning of their coloration. There seems to be a large tropical element, brought, no doubt, by the Kuro Siwo. After some weeks' investigation of the shallow-water fauna, Dr. Doflein returned to Tokio to hire a small steamer for deep-water work. The first vessel that he chartered sank off Misaki, near Aburatsubo, and thus wasted precious weeks of fine weather, but with another he was able to do good work, both on the

plankton and on the ground-fauna at various depths down to about 900 fathoms. Much material was also obtained for him by Japanese deep-sea fishermen with "Dabo" lines.

In summer the warm Kuro Siwo waters cover the surface of Sagami Bay, but in winter the north-west winds bring down the cold current to overlie it, so that the self-registering thermometers reveal a layer of warm water between two cold layers. In this warm layer the fauna of the Kuro Siwo is found, while the surface layer has a very different and largely vegetable plankton. As has been said, there is great mortality among both these sets of organisms, with the result that the ground-fauna at all depths, from tide-marks downwards, is extraordinarily rich. The broken nature of the sea-bottom, providing a greatly increased surface and variety of habitat, no doubt contributes to the same result. Another peculiarity of the fauna of Sagami Bay is the appearance in very moderate depths, of sometimes as little as fifty fathoms, of forms which have usually been found considerably lower, at 500 fathoms to 1500 fathoms. Doflein accounts for this partly by the suitably low bottom temperature, but more by the stillness of the water. Many of the so-called deep-sea forms are, he says, more properly still-water forms, specially adapted to absence of motion rather than to the other peculiar conditions of the deep sea, and their vertical range would probably be found to be considerably greater were the same attention to be paid to the exploration of intermediate depths that has been given to the investigation of the shore-belt and the deep sea. This surmise appears extremely plausible.

Bad weather and accidents to his apparatus brought the investigations once more to a standstill, and Dr. Doflein left Japan. On his way home he stayed in Ceylon, and he gives an interesting account of his researches on fungus-growing termites there. Some remarks on the spinning ant Œcophylla bring the book to a close. We have read it with great pleasure. The scientific portions are in places very suggestive, the chapters on the ways and customs of various countries, and especially of Japan, are bright and attractive, and the numerous illustrations are often really beautiful. L. A. B.

BIRD BOOKS FOR BEGINNERS.

A Handbook of British Inland Birds. By Anthony Collett. With coloured and outline plates of eggs by Eric Parker. Pp. xix+289. (London: Macmillan and Co., Ltd., 1906.) Price 6*s*.

A Pocket-book of British Birds. By E. F. M. Elms. Pp. viii+150. (London: West, Newman and Co., 1906.) Price 2*s*. 6*d*.

IF in these days the way is not made smooth for the young ornithologist it is not for lack of books written in his interest. Mr. Collett thinks that there should be a useful place for a book in which the space gained by omitting the sea and shore birds is devoted to a closer account of the inland species, and the chief intention of his handbook is to supply as plain and simple a means as possible for the identification of those birds, and their nests and eggs, which are to be met with in the inland districts of this country, and are therefore more likely to cross the path of the greater number of persons interested in bird life. Knowing his birds thoroughly well, the author has written most charming and interesting accounts of them, and his long experience of them in the field has enabled him to introduce into his sketches much of the individual character and temperament of each species—those little peculiarities a knowledge of which is only to be gained by long acquaintance, and by which the old hand knows his birds at a glance or by a note heard in the distance. When the object is to teach the beginner in the study this intimate knowledge is very necessary, and all birdmen (who will read the book for the pleasure it will give them) will recognise and appreciate the happy touches of description which arise from it.

As the book will, we think, be in some demand, we offer a few suggestions in view of another edition. To give the salient features of the general appearance of a bird as seen at a little distance should not be difficult, but the descriptions here, in many cases, seem to be hardly sufficient. The fieldfare, for instance, is merely differentiated from the missel thrush (in plumage) as having a more distinct grey patch on the lower part of the back; whereas its greyish head, rich brown mantle, and the blue-grey of the patch on its lower back (from which the bird is sometimes called the "pigeon" felt) might have been pointed out as sufficiently apparent to serve as identification marks. The short wings of the sparrow-hawk might have been alluded to, as well as the want in the cirl bunting of the bright chestnut rump so conspicuous in the yellow hammer; the distinctly colder tints easily seen in life of the marsh compared with those of the reed warbler, and the streaked under parts of the adult Montagu's harrier are merely further instances of the kind of recognition marks we wish to indicate.

As the book is intended for readers whose knowledge of ornithology is of an elementary character, something more about the plumage of the chaffinch than the statement that the hen bird is a good deal duller than the cock is desirable, and the want of it is all the more felt, because the following species, the brambling, is said rather closely to resemble the chaffinch, and is described in comparison with it. The whitethroat is described as if it were uniformly coloured on the upper parts, whereas the greyish head contrasts with its rufous-brown back; and as we are dealing with birds seen at a little distance, it would have given a better idea of the cock stonechat to say that he had a black head than that he had a conspicuous black patch on the throat and face. We should not have said that the pied fly-catcher had the appearance of being of slender build, nor can we detect that the eggs of the whinchat are usually a good deal greener and deeper in tint than ordinary hedge-sparrows' eggs. The author thinks

that the notion that the mistletoe thrush haunted apple trees for the sake of eating mistletoe berries, and hence got its name, is not confirmed by the bird's actual habits; but we have it on the authority of our greatest living ornithologist (an opinion based on personal observations) that the connection of the bird with the mistletoe is no figment, as some have tried to maintain, and that this thrush is exceedingly fond of the luscious viscid berries of the mistletoe.

While fully allowing that the attempt to put a bird's note into syllables is in most cases a failure (so far as people in general are concerned), there are exceptions, and it would surely have been desirable in the interests of the young field ornithologist to give in words as many of the more remarkable bird-notes as lend themselves to this treatment. The "you-tick" of the whinchat and the "twit me-dick" of the quail (from which the birds take local names), the "hweet-tit-tit" of the redstart and the "chuck-chucka" of the red-legged partridge, are a few cases in point. But to take the case of the curlew as here treated, no mention is made of the fact that some of its varied cries have suggested names for it, and the remark that "the cry recalls some of the notes of the plover, but is far more free and powerful," hardly seems to convey an adequate idea of the curlew's characteristic cries. We wonder if the song of the lesser whitethroat would strike most people as more "quiet and unobtrusive" than that of the whitethroat.

The descriptions of the nests and nesting habits are especially successful, and will be most interesting to experienced bird-nesters, as well as useful to the novice. The coloured figures give, on the whole, a good idea of the eggs, although some of the plates suggest three-colour printing, and that one colour has obtained undue prominence. White eggs are merely figured in outline, and the artist has succeeded in representing the characteristic shape of average specimens. An index, which is all that can be desired, and a classified list of breeding species and regular visitors make reference to the different species easy; but we cannot understand the application of the note to the latter, that the visitors are distinguished by italics, for we find very few names so treated, and among them those of both the yellow and the grey wagtails.

Mr. Elms's thin volume, which slides so easily into the pocket that there is no excuse for leaving it behind on a field day or omitting to take it out every morning during the migration seasons, is intended solely for the purpose of reference in the field. All our British birds (properly so-called) are included, the rare and accidental visitors or stragglers to our shores hardly coming within the scope of the book, as the chances of seeing them during a country ramble are very slight. A vast amount of information has been included in the small compass of this pocket-book; the plumage, period of residence in this country, language, habits, haunts, and food are all treated concisely under their several headings, as well as some particulars of the nidification; but in the last respect it is pointed out that the present volume is intended to be used and carried in conjunction with the new edition of Newman's "Bird-nesting and Bird-skinning," which is of the same size and issued by the same publishers, and contains full particulars of the nests and eggs. Some of the observations on bird language, those on some of the gulls and terns, for instance, do not appear to be altogether satisfactory, but this handy little volume (which is furnished with a good index) cannot fail to be of great service to the student of field ornithology.

A GUIDE TO BRITISH DIPTERA.

A Preliminary List of Durham Diptera, with Analytical Tables. By the Rev. W. J. Wingate. Transactions of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne. (New Series.) Vol. xi. Pp. vii+416; with seven plates. (London and Edinburgh: Williams and Norgate; Newcastle-upon-Tyne: F. and W. Dodsworth, 1906.) Price 9s.

THE author, or, as he would probably prefer to be styled, the compiler, of this excellent manual has done himself less than justice, for if, instead of the modest title associated with the name of a single English county, he had chosen some such designation as that at the head of this notice, he would more accurately have expressed the scope of his work and would also, perchance, have brought the latter to the notice of a wider circle of readers.

Little by little budding entomologists in this country are beginning to realise that butterflies and moths and beetles are not the only orders of insects worthy of study, and the number of those who devote their energies to the flies, or Diptera, though still small by comparison with that of the students of the more popular orders, is steadily increasing. As Mr. Wingate truly remarks in his preface, no other order of insects "has so many interesting and varied life-histories, and none so deeply affects the human race, whether as protectors when acting the part of scavengers, or depredators destroying the crops, or scourges carrying the deadly micro-parasite." Unfortunately for the beginner, the bulk of the literature dealing with European Diptera is in foreign tongues, chiefly German, and, Walker's "Insecta Britannica" being hopelessly inadequate and out of date, it has hitherto been impossible to satisfy the natural demand of the novice for a work in English that, while supplying an outline of the structure and classification of Diptera, will at the same time provide the means for the identification of the bulk of the British representatives of the order. The basis for all work upon British Diptera is, of course, Verrall's "List," the second edition of which was published in 1901. In this are the names of 2884 species, and when it is added that Mr. Wingate's tables, which are chiefly derived from Schiner's classical work on the Diptera of Austria, furnish characters for the determination of no fewer than 2210 of these, it will be seen that the present volume should go far towards supplying the British student with precisely the aid that he requires. In addition to those already mentioned, details are

also given of a number of species either identified as British since the appearance of Verrall's "List," or which may ultimately prove to be so, with the result that "characters more or less satisfactory are given for 2526 species," with "localities for 626 of these" which Mr. Wingate has himself collected in the county of Durham during the last ten years.

Turning to the actual contents of the volume before us, we find that, after a couple of pages on collecting and preserving, eighteen pages are devoted to a synopsis of the external morphology of Diptera in the form of a description of a "Fly Chart" (Plate i.) or diagram of a hypothetical Dipteron, so arranged as to display all or most of the characters used in descriptions. This is followed by an analytical table of families, which occupies ten pages, and the remainder of the book, with the exception of a few pages of addenda and indices, consists of tables for the determination of genera and species. In addition to the fly chart, which we think would have been clearer had the shading been omitted, characteristic structural details, such as antennæ, wings, legs, &c., are represented in the six following plates.

So much care and thoroughness have evidently been expended upon this work that there is little room for criticism of any kind; a few minor emendations may, however, be pointed out. On p. 198 attention should have been directed to the vertical stripes of longer hair on the eyes of the common drone-fly (*Eristalis tenax*, L.), which are an easily recognised and distinctive feature of the species. Speiser's name Varichæta is used (pp. 212, 228) for the preoccupied Erigone, Rob.-Desv., instead of Ernestia, Rob.-Desv., which Bezzi has recently shown to be the correct designation. It should be noted that *E. strenua*, Mg., is a synonym of *E. rudis*, Fln. The life-history of *Lipara lucens*, Mg., is not "unknown," as stated on p. 361; the larva mines in the heads of reeds. The Phoridæ (p. 383) are placed in their time-honoured position among the Cyclorrhapha, following the Borboridæ (as in Verrall's "List" of 1901), though, as shown by Osten Sacken, the true affinities of these very aberrant Diptera would appear to be with the Orthorrhapha, the more primitive of the two main divisions of the order. The bionomic notes on the strange-looking Hippoboscidæ (pp. 394–5) lack something in precision: *Hippobosca equina*, L., stated to be "parasitic on quadrupeds, especially horses," is a parasite of horses and cattle; *Lipoptena cervi*, L., also described as "parasitic on quadrupeds," is found on red and roe deer; *Stenopteryx hirundinis*, L., so far as the present writer is aware, is met with on young house-martins, not on young "swallows"; and *Oxypterum pallidum*, Leach, is a parasite of the swift, not of the swallow. As already stated, however, these are details of minor importance. By the publication of this work Mr. Wingate has earned the gratitude of all who are interested in British entomology, and it is to be hoped that, as the result of his labours, he may have the satisfaction of witnessing a considerable accession to the ranks of British dipterists. E. E. A.

OUR BOOK SHELF.

Illogical Geology. The Weakest Point in the Evolution Theory. By George McCready Price. Pp. 96. (Los Angeles, California: The Modern Heretic Company, 1906.) Price 25 cents.

THE author of this book proposes to collect the opinions of his readers, and a printed form is appended on which comments may be recorded. There is little doubt that a writer so much in earnest will make some modifications in his next edition as the result of friendly criticism. But geologists who have taken the pains to base their conclusions on hard work and study in the field, and not on the perusal of each other's text-books, will remain unsatisfied with Mr. Price until he also has undertaken a course of geological observation. In his introduction he offers a munificent sum to anyone who will "show [him] how to prove that one kind of fossil is older than another." It is not until we read his book that we perceive the intellectual difficulty of accepting this sporting proposition. For Mr. Price believes (p. 20) that geologists assume "that in the long ago there were no such things as zoological provinces and zones"; he believes that (p. 30) the inversion of stratified deposits is nowhere proved by physical evidence; that (p. 46) there are "numerous families" of molluscs and brachiopods which disappear suddenly and completely with early Palæozoic times, and yet are found alive now in our modern world; and that (p. 68) the custom of classifying the Tertiary strata by the relative percentage of living and extinct forms that they contain is "utter nonsense." If Mr. Price would join one of the field-parties from some American university, he would soon find that his quarrel must be with natural phenomena, and not with an imaginary hierarchy of illogical geologists.

G. A. J. C.

The Religion of Nature. By E. Kay Robinson. Pp. xii+215. (London: Hodder and Stoughton, n.d.) Price 3*s.* 6*d.*

MR. ROBINSON has written a book that is sure to interest a large number of readers. His object is to show that there is no cruelty in nature, that animals are not self-conscious, and, therefore, that such pain as they feel is not pain of the kind that human beings are familiar with. It is only "the natural bodily protest of a living organism against injury"; and since there is for animals only this painless pain, and since their cruelty is not really cruel, "there is in nature nothing antagonistic to the principles of revealed religion.

No one who knows anything about animals can fail to realise that their capacity for suffering is much exaggerated by extreme humanitarians. A highly-bred pigeon will undergo an operation for hernia apparently without feeling it, and directly it is over will begin quietly to eat his Indian corn. Animals do not suffer in anticipation, they do not brood over the past, and the actual torture, as everyone knows, is often far less than the picture of it that haunts the mind before and after. Let us hope, therefore, that all unreasonable humanitarians will read this book. In the opinion of the present writer, though Mr. Robinson fails to prove his main thesis, yet he makes it clear that the sufferings of animals as compared with those of men are as moonlight to sunlight. In fact, the human race has almost a monopoly of misery as distinguished from short spells of pain.

We can only very briefly trace Mr. Robinson's line of argument. A sensitive plant behaves as if it had feeling, but, being a vegetable, it cannot feel. A sea

anemone is an undoubted animal, yet it is not on a higher level than the sensitive plant; it only closes when touched. The argument here is a *reductio ad absurdum*. If you recognise consciousness in the lower animals you must also recognise it in plants. To which we may reply, "Why not?" They may have a very dim rudimentary consciousness. Deny consciousness to all animals except men, and you are confronted with greater difficulties than this. We all believe in evolution. Mr. Robinson himself accepts it. Consciousness must, therefore, have shown itself first in a rudimentary form. Evolution does nothing but develop the powers of which we find suggestions in the simplest forms of life. Nothing, therefore, can have its first beginning in the highest form of life; in the more intelligent animals it is difficult to believe that consciousness is entirely rudimentary. Mr. Romanes's monkey that got possession of the key of a chest and tried hard for two hours to unlock it must have had a fair allowance of self-consciousness. Dogs have dreams. Why may they not even when awake think over their recent fights and adventures? Animals learn by experience; pleasure and pain are the great educators for them as for us. Whittle their pleasure and pain down to nothing, eviscerate both the one and the other of all reality, and how could they steer their course amid the rocks and shoals of life?

Mr. Robinson ends by making a damaging admission. Men, he says, can educate animals and elevate them; but education can only bring out what is already present. There is, therefore, in animals, whether wild or domesticated, something beyond that which Mr. Robinson would concede to them.

Carboni fossili inglesi. By Dr. Guglielmo Gherardi. Pp. xvi+586. (Milan: Ulrico Hoepli, 1906.) Price 5*s*.

It is undoubtedly advantageous "to see oursels as ithers see us," and the British coal-miner has an excellent opportunity of doing so by studying this attractive manual on British coals, cokes, and briquettes from the pen of an experienced Italian works-chemist. The book is divided into four parts. In the first the various coals are dealt with from a theoretical point of view, the methods of analysis, both rapid and exact, being described in detail. In the second part the British coals are described under the head of the various coalfields, numerous analyses being given, with full references to the sources from which they were obtained. In the third and fourth parts the manufacture of coke and of briquettes receives attention, the subject being one of special importance for the future development of Italian industries. The manual concludes with five maps of the coalfields, and with various appendices containing useful information for the coal merchant. The book, which is the first of its kind written in Italian, cannot fail to prove of value to Italian manufacturers desirous of securing the greatest heating effect with the least expense, by supplying them with accurate information regarding the nature of the coals they purchase. It is written with care and impartiality in a concise and lucid style, and, like all the volumes of the well-known series of "Manuali Hoepli," is produced in a tasteful manner at a modest price.

How to Find and Name Wild Flowers. By Thomas Fox. Pp. xvi+265. (London: Cassell and Co., Ltd., 1906.) Price 1*s*. 6*d*.

Does the natural system of botanical classification present many difficulties to the beginner? Is the Linnean system simpler? Can an easier method of identification than either of these two be devised? If so, what are the advantages and disadvantages? To those interested in these questions, especially the last, this book is offered as an attempt to provide a solution. The primary means of identification are furnished by the month in which the flowers appear and their colour, after which the size and other details of the flower are taken as the most general guide. With what results? Side by side in the same category are found the frogbit, Italian catchfly, floating water-plantain, common feverfew, and the large-flowered winter-green. This series was taken at random, but is probably one of the most extreme instances. Does a non-technical method of discrimination compensate for this mingling of unallied plants? Will the learner be led to associate them together? Will not considerable difficulties arise with regard to the exact size, also with regard to the colour? As for comparison, after becoming conversant with a flora according to one system it is not easy to gauge the merits of another; but to those wishing to identify plants, and to whom the natural system offers great difficulty, this book may be recommended as an earnest endeavour to provide a substitute.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

American Chemists and the Jubilee of the Coal-tar Colour Industry.

In justice to our American colleagues, I think it necessary to supplement the paragraph which appears in your "Notes" of last week (p. 496), and is similar to a statement published in the *Times* of September 6, by the following explanation:—

When the international movement was inaugurated here last February at the meeting held at the Mansion House, America was, of course, invited to participate in the scheme which had been adopted at the public meeting, and for the carrying out of which a fund had to be raised. In response to our invitation, a meeting of American chemists was convened in New York and a number of proposals considered, the final outcome being the scheme set forth in the paragraph published in your issue of last week (September 13). From this it would appear that the Americans had cut themselves adrift from the international movement, and had decided to have an independent celebration in honour of Sir Wm. Perkin and his work. From their point of view—the promotion of chemistry in their own country—there was, of course, very good reason for the line of action which they had decided upon taking, but it is also obvious that their scheme, as published, is purely local, and that if this represented their whole project there would have been every justification for the view taken by our executive committee, that the Americans wished to detach themselves from the European movement.

It is necessary, therefore, to add that the scheme published last week does not represent the latest phase of the American celebration. In addition to the objects set forth in that scheme, provision is made for receiving contributions to the Perkin research fund, founded here as part of our scheme, and loyally supported by all the contributing nations, the representatives of which at the last general meeting of the executive committee on July 27 unreservedly added their contributions to the general fund to be administered through our Chemical Society. At that meeting, as also at the general international meeting at the Royal Institution the previous day, the official representative of American chemists, Dr. Leo Baekeland, confirmed in public the cablegram which we had received from the American committee announcing its decision to cooperate with us and to contribute to our scheme.

The American programme, therefore, is not so purely

local as it appears when set forth without qualification. The objects which our Transatlantic colleagues are desirous of carrying out in the name of our distinguished countryman will, I am sure, have the entire sympathy of all English chemists, and, for my own part, I can only wish that every success may attend their celebrations next month. At the same time, I may point out that research in this country is very poorly endowed as compared with the munificent foundations for this purpose established by wealthy Americans. We may, therefore, while wishing that the American jubilee will be productive of all the results which they themselves desire, appeal with confidence to Americans to support also that other part of their own scheme which provides for the endowment of our Perkin research fund.

R. MELDOLA.

Blair Atholl, Perthshire, September 15.

Horizontal Pendulums and Earthquake Echoes.

I HAVE just finished reading Captain Dutton's book 'Earthquakes in the Light of the New Seismology," the preface of which was written in April, 1904, while the date of publication is 1905. I mention these dates because a paper of mine, bearing particularly on chapter vii. of the book, was read before the Physical Society on March 13, 1903, and appeared subsequently in the Proc. Phys. Soc., vol. xviii.; it also was published in the *Phil. Mag.* for October, 1903. I gather, however, that Captain Dutton has not seen the paper, and as I am not certain of his exact address I am addressing you.

To be candid, I say that Prof. Milne has not considered the effect of resonance sufficiently, if at all, in computing the tiltings represented by his seismograms. Certain screws are placed in the base-plate of a Milne seismograph partly for levelling purposes and partly to give the base a known tilt. Prof. Milne has argued thus (*vide* almost any British Association report): if a tilt of 1″ given to the base displaces the end of the boom 1 mm., then a seismogram of 10 mm. amplitude indicates a tilt of 10″, if it indicates a tilt at all. On this assumption Prof. Milne discusses the tilting theory and discards it (the theory), and also on this view Captain Dutton's seventh chapter is based. That it is a wrong view my diagrams as well as ordinary mathematics show.

I have also given a more prosaic explanation of Prof. Milne's "earthquake echoes" than is to be found in either the British Association reports or in Captain Dutton's book, pp. 235–6. The tilt represented by any seismogram is a function of the boom period, the wave period, the log. decrements of the free vibration of the boom, and of the earth wave, and is, in general, very much smaller than that which is given in the British Association reports. Earthquake echoes may be regarded as interference effects between the free and forced vibrations. I notice that in the diagrams in my paper referred to the fifteen-second wave diagram which shows these interference effects best has been turned round with regard to the others. With the exception of this one, the artificial vibrations all start to the right, and are continued regularly until the end of the diagram is reached, when obviously the swing of the boom dies away naturally.

C. COLERIDGE FARR.

Canterbury College, Christchurch, New Zealand, July 21.

In a report to the British Association in 1899 I directed attention to the fact that as an earthquake dies its seismograms indicate that it does so in a series of more or less rhythmically decreasing impulses. These, I suggested, were more likely to result from reflection than from interference, and therefore they were provisionally called echoes. Four years later (*Phil. Mag.*, October, 1903) Dr. C. Coleridge Farr discussed the terminal wave group as interference effects between the free period of the recording boom and the period of the ground. Theoretical considerations show their existence, whilst an ingenious experiment carried out by Dr. Farr shows that it is not difficult to reproduce wave groups strikingly similar to those shown in many seismograms. On the two sides of a pillar carrying a pendulum with a period of 16·5 seconds Dr. Farr attached two boxes filled with sawdust. Two chains connected by a rope passing over pulleys hung over the centre of each box. This arrangement was worked up and down at a fixed speed, so that while one side of the pillar was loaded the other was unloaded. By working this arrangement, tiltings were given to the column representing groups of waves with periods varying between twelve and twenty seconds. The resulting diagrams gave three results:—

(1) The amplitudes were greater than those due to steady loading.

The inference is that a horizontal pendulum does not correctly measure the amplitudes of the greater portion of a teleseismic disturbance, a conclusion long recognised by most seismologists. Why, therefore, it may be asked, are columns of figures relating to amplitudes continually appearing in earthquake registers? One reason is that they roughly give relative magnitudes for movements recorded at widely separated stations, and are, therefore, of great value in determining origins. When expressed in angular measure, if the corresponding periods of movement exceed two minutes it is likely that the pendulum has closely followed the tilting which has been recorded. Other reasons may be adduced to indicate that "amplitudes" have a value, and it is, therefore, desirable that they should be retained in registers.

(2) Although the period of the forced vibration was varied in different experiments, the resultant diagrams showed that the pendulum followed the tiltings of the pier.

The converse of this is found in the observation that pendulums with different periods will record the same periods for groups of waves in a given earthquake.

(3) The diagrams showed marked interference effects. For example, forced vibrations of fifteen seconds acting on a pendulum with a period of 16·5 seconds yield a series of throbbings very similar in appearance to many seen in a seismogram.

Although I entirely agree with Dr. Farr as to the existence of interference effects of this description, this by no means excludes the existence of reflection effects or echoes. To commence with, we will consider the first great echo, or Yuri Kaishi. The Yuri Kaishi, or return shaking, which frequently occurs about four minutes after the first shock, was recognised and christened long before the invention of modern seismographs. You feel it, you may see its effects, and, within a meizoseismic area, a seismograph is not required to give evidence of its existence. To regard it as an imaginary reinforcement of earth movement due to a want of synchronism in the period of the same and that of a horizontal pendulum is out of the question. The Yuri Kaishi rattles doors and windows, and causes people to leave their houses. My own view of the phenomena is that it is similar to what is seen when a bullet is dropped into the middle of a large tub of water. Waves travel outwards to the sides of the tub, where they are reflected, after which they converge at the centre from which they started. In nature, the reflecting surface may possibly be represented by the roots of mountain ranges. As these may be at varying distances from the origin of the disturbance, the reflections will give rise to complications at the focus. The transmitting medium I take to be that material beneath the heterogeneous superficial covering of our earth which transmits large waves with a constant velocity of about 3 km. per second.

A megaseismic primary and its echoes may be transmitted to very long distances, and as they travel may by reflection at other surfaces be still farther broken up into minor wave groups. Two wave groups within a megaseismic area might at a great distance from an origin be represented by four groups, and so on. This matter has not yet been carefully looked into, but evidence exists that wave groups increase in their number with distance from an origin (British Association Report, 1897, p. 68).

In support of the explanation I offer for the Yuri Kaishi it may be mentioned that the time interval between it and its primary is in those cases where we know the distance between an epifocal area and a supposed reflecting surface,

such as might be anticipated. As an illustration of this I will take the Californian earthquake of April 18. This originated along lines of great length on the western side of that country. The reflecting surface I take to be the Sierras, 200 miles distant. A wave group would travel to the Sierras and back in about four minutes, and this is approximately the time interval between the two first large wave groups in the few seismograms I have of that disturbance.

In offering these suggestions I concur with Dr. Farr that very frequently terminal vibrations of an earthquake present characteristics suggestive of interference effects, but it is premature to suppose that all the peculiarities of a seismogram are to be explained in the same manner. Rhythmical beats at an origin may result in rhythmical beats at a distance. JOHN MILNE.

Shide, Isle of Wight, September 5.

Remarkable Rainbow Phenomena.

ON Monday, September 3, a very heavy thunder-shower passed from west to east over the parish of Deerness, Orkney, from 5.30 p.m. to 6.25 p.m. When the dark nimbus cloud to the west had lifted its pall, the sun came out in great brilliancy. A rainbow now began to form to the north-east, but instead of the ordinary bow there was one of a bifurcated nature. Two stumps which coalesced on the horizon gradually developed into two magnificent bows, which met on both horizons, viz. north-east and south-west, but were about five or six degrees apart at the apex. All the colours of a radiant bow were present in both, and both had the colours arranged in the order of the primary bow. The secondary bow also appeared with the colours reversed and the same bifurcation, but in this case it extended only to about thirty or thirty-five degrees above the horizon, as secondaries generally do. As I had never seen or heard of anything like this, my first impulse was to find a cause. When the double rainbows were at their best, there was a bar of stratus cloud extending across the middle of the sun, and in breadth about one-sixth of its diameter. The two primary bows remained complete from 6.30 p.m. to 6.35 p.m., and without the arc of the apex for about another five minutes.

At first the bow to the south was the more complete, and finally the one to the north. However, after the sun had crept from behind the bar of cloud there were still double stumps clearly visible. If the cause here attributed be correct, then the only explanation of the bifurcated rainbow being visible after the cloud passed is, that from the points of the heavens where the rainbows were the bar might still be dividing the sun's rays. Nothing in my meteorological books indicated that this phenomenon had been previously seen. On inquiring as to what others had seen after the thunder-shower, two friends, one five miles and the other three miles almost directly west of me, saw only a perfect bow and its secondary. Others nearer the position I occupied saw what they called four rainbows, but had observed neither the coloration nor bifurcation clearly enough for descriptive purposes. M. SPENCE.

Deerness, Orkney.

The Mixed Transformation of Lagrange's Equations.

MR. A. B. BASSET, in a letter to NATURE of August 2, states that the theory of the mixed transformation was first given by himself in 1887, and refers to his treatise on "Hydrodynamics," vol. i., p. 171. If he will kindly look at my essay for the Adam's prize, pp. 61–4, he will find an elimination similar to that which he speaks of. The resulting modified functions appear to agree term for term. There is also the introduction of a "modified function" by which we can use Lagrange's equations for some of the coordinates and Hamilton's equations for the others. That essay dates from December, 1876, and was published in August, 1877. The method was afterwards explained without much change in all the editions of my "Rigid Dynamics" which follow that date, beginning with the fourth edition, 1882. E. J. ROUTH.

September 14.

THE RECENT CONTROVERSY ON RADIUM.

THE recent correspondence on the subject of radium, started in the *Times* by Lord Kelvin, has, after lasting nearly a month and causing widespread interest, apparently closed without any very definite conclusion being reached. Whatever opinion may be formed of the merits of the controversy, all must unite in admiration for the boldness with which Lord Kelvin initiated his campaign, and the intellectual keenness with which he conducted, almost single-handed, what appeared to many from the first almost a forlorn hope against the transmutational and evolutionary doctrines framed to account for the properties of radium. The weight of years and the almost unanimous opinion of his younger colleagues against him have not deterred him from leading a lost cause, if not to a victorious termination, at least to one from which no one will grudge him the honours of war. If peace and tranquility now result, and a measure of agreement is arrived at between conflicting views, it will be a result which all concerned will heartily welcome. The most ardent believer in the truth of the new doctrines cannot be other than satisfied that every feature and assumption that is admittedly speculative should be clearly recognised as such and separated from that which is not, if thereby the experimental foundations of the science of radio-activity are freed from further wordy and unprofitable controversy. There seems now to be a reasonable prospect that this has been secured.

Lord Kelvin's opening challenge (August 9) was broad and sweeping. He took exception to the statement, made by the writer in opening the discussion on the evolution of the elements at the British Association at York, that the production of helium from radium has established the fact of the gradual evolution of one element into others, and denied that this discovery affected the atomic doctrine any more than the original discovery of helium in cleveite. The obvious conclusion was that both cleveite and radium contained helium. He also stated that there was no experimental foundation for the hypothesis that the heat of the sun was due to radium, and ascribed it to gravitation.

The challenge was taken up on the other side successively by Sir Oliver Lodge, the Hon. Mr. Strutt, and other well-known authorities, and it soon became apparent that for argument at least Lord Kelvin on his side had to rely practically on himself alone. Prof. Armstrong, it is true, immediately enrolled under Lord Kelvin's banner, and entered the lists with an embracing criticism of physicists in general, whom, he declared, are strangely innocent workers under the all-potent influence of formula and fashion. He made the statement that no one had handled radium in such quantity or in such manner that we can say precisely what it is, and throughout put the word *radium* in inverted commas.

Whether or no his opponents are all as innocent and ignorant as Prof. Armstrong imagines, the fact remains that, except for this *ex cathedra* utterance and a leading article, argument against the accepted view there was little or none except that contributed by Lord Kelvin himself. Prof. Armstrong's letter merely served to provide Sir Oliver Lodge with justification for his favourite theme, which appears to be that whereas chemists have an instinct of their own for arriving at their results, reason is the monopoly of the physicist, whose results the chemist usually manages to absorb in the end. No better argument against the unfairness of this could be provided than by the history of radio-activity itself, which

owes at least as much to the chemist as to the physicist. Prof. Armstrong is almost alone among chemists, as Lord Kelvin is among physicists, in his hostility to the new doctrines.

Mr. Strutt in two letters (August 9 and 21) asked what became of the heat generated by the radium admitted to be present in the earth, and recalled the independent evidence of several workers of the continuous renewal of helium from radium. Sir Oliver Lodge directed attention to the magnetic deflection of the α-particle as evidence that material particles are expelled from radium, and in his letter laid perhaps undue weight on the evidence, which is still far from complete, that the α-particle is an atom of helium. The vagueness of this argument, and the fact that the letter raised a doubt whether Lord Kelvin had sufficiently examined the published evidence, a doubt which Lord Kelvin himself promptly dispelled, was the subject of a leading article in the *Times* of August 18. The writer of that article attacked the evidence for the production of helium from radium, using some well-known arguments. The minute quantity of emanation was graphically likened to a bubble rising through a glass of whiskey and soda, and it was held that the results were vitiated by the well-known changes the spectra of gases undergo under the prolonged action of the current, due to occlusion by the electrodes and selective conduction rather than to any transmutation. It may be here remarked that the same arguments were set forth in full by Himstedt and Meyer as a preliminary to their experimental examination of the question, yet Himstedt and Meyer, as the result of their own experiments, were finally forced to the conclusion that helium is in fact produced from radium.

Lord Kelvin in his replies (August 20 and 24) made it clear that he accepted as a fact the continuous evolution of helium from radium, and this admission narrowed very much the issue involved. In reply to a statement of Strutt that if all the helium is removed from radium after an interval a further supply can be extracted, Lord Kelvin remarked simply that the *if* of the statement was wrong. This point was dealt with by the present writer (August 31), who considered the argument could be definitely answered. For helium is produced from the emanation of radium, about which no question of its being really reproduced can exist. For the removal of the emanation is marked by changes in the radio-activity, notably by the β rays, which vanish when the emanation is removed. The recovery of the radio-activity occurs at a definite rate, and is concomitant to the reproduction of emanation, which can at any time be again extracted as before. As there is no question of the radium creating helium, the only point open for argument is the exact character of the decomposition by which it and the emanation which gives rise to it are formed. As there was no further reply to this criticism, it may be taken that the main point of the disintegration theory, that there is a continuous change in the radio-active matter accompanying the radio-activity, is unanswerable.

On the important question as to the character of the decomposition by which the helium is formed, Lord Kelvin in his later letters favoured a view very different from that of mere occlusion, which the original analogy to cleveite suggested. He quoted a statement of Prof. Rutherford in favour of regarding radium as a chemical compound of helium and other elements, and suggested that radium might be made up of one atom of (?) lead and four of helium. In a final letter (September 4) Sir Oliver Lodge pointed out that this was the key of the position. Is radium a compound or an element? It is satisfactory that, after so much fencing with the question, so simple an alternative has been arrived at. Perhaps the most significant thing about the view that radium is a compound is the silence of the chemists. Surely a chemist might fairly be supposed to know whether a change is what is called a chemical change or not, and the fact that it has been left to a physicist to adopt this view seems fair comment. Not even Prof. Armstrong has yet accepted it.

On the second point of his challenge, the denial that the heat of the earth is due to radium, Lord Kelvin naturally had an easier task, for matters connected with the interior of the earth must necessarily remain speculative. If radium did not decompose under the conditions prevailing in the interior it would emit no heat, and would not tend to diminish in quantity, accounting perhaps, although with some difficulty in view of the wide distribution of radium in surface rocks, for the continued existence of the substance at the present time. Mr. A. S. Eve, in a vigorous letter (August 28), stated that he had confirmed the estimate of Mr. Strutt of the amount of radium in the earth's crust by a new method, in which the penetrating radiation from the earth's surface was used as the basis of measurement. Although, of course, in view of the evidence of the independence of radio-active changes upon their environment, it is more of an assumption to suppose that in the interior of the earth radium does not decompose than to take the opposite view, yet clearly here, at any rate, there is plenty of room for legitimate differences of opinion. On the other hand, even the opponents of Mr. Strutt's view cannot deny the potentialities of radio-activity, and the part it might play in cosmical processes under favourable conditions.

The theory that radium is a compound, waiving the qualification *chemical*, will no doubt serve sufficiently well for the present as a point of common agreement. As Sir Oliver Lodge remarked, there is no necessity that the question be settled offhand. As a stepping-stone to further conclusions, it offers advantages to the conservative and cautious. It expresses a bare minimum of established fact which even the most sceptical are unable to invalidate. This minimum, briefly stated, is that radium is undergoing a continuous change intimately connected with its radio-activity, and that in this change helium is produced, and an enormous but definite amount of energy liberated. Whether anything more is known about transmutation now than formerly, whether lead could change into gold or gold into silver with an emission of energy similar to that evolved from radium, whether this or similar energy plays the large share that has been attributed to it in cosmical processes, are questions which may be legitimately discussed and left open, if only for the reason that they are far from decided. They are all admittedly steps into the region of hypothesis.

But what a miserable fraction, even of the known facts, this minimum is! Ostensibly an explanation of radio-activity, it begins and ends with the fact of the gradual evolution of helium from radium. The numerous other products of radium, the volatile emanation and its non-volatile products, known by their characteristic radio-activity, much as minute quantities of ordinary gases and solids are known by their characteristic spectra, the slower changing later products, of which polonium is one, and is chemically as reminiscent of tellurium as its parent is of barium, remain still to be systematically accounted for. On the important subject of the nature of the α, β, and γ rays, and their origin, the view is silent! The fact

is ignored that radio-activity is, to use Mme. Curie's happy expression, an atomic property, that is, is independent of the particular state of chemical combination of the radio-element. Radium resembles in the closest possible manner barium, a completely inactive element in the same family of the periodic table, both in chemical nature and in the series relationships of its spectrum. Barium is an element, radium is a compound; but whether uranium and thorium are elements or compounds is undecided. Again, the emission of energy, greater a million-fold than that evolved in any previous material change, remains a mystery in company with the discrepancy between the physical and geological estimates of the age of the earth. The constancy of ratio between the quantities of radium and uranium in all natural minerals is another experimental fact unexplained.

It is the glory of the accepted view that it harmonises and correlates all the preceding problems, offering a simple and unstrained physical explanation of each, capable of being tested by quantitative experiment. In addition, it reaches out in every direction in broad, bold predictions, a few of which, like the production of helium from radium and the constancy of ratio between uranium and radium in minerals, have been brilliantly confirmed by experiment, while the majority simply await more refined experimental methods of attack. Of what other theory could the remark be made, which is attributed to Prof. Rutherford, that when a single experimental fact is established which does not conform to the disintegration theory it will be time to abandon it? The theory would have to be fundamental indeed to pass this test.

The secret of the vague hostility to the new doctrines which the recent controversy has shown to be widely felt is to be found probably in the impossibility of forming from words or reading the least idea of the really startling character of some of the new discoveries. This is particularly true of perhaps the most wonderful of them all, the radium emanation. Even Lord Kelvin in one of his letters speaks vaguely of emanations, while Sir William Crookes, at least until quite recently, employed the word, also in the plural, as a generic term for the *radiations*. Give a scientific man a few milligrams of radium in solution and ask him to perform for himself some of the stock experiments with the emanation, for example, its condensation by liquid air, the concentration on the negative electrode of the active deposit formed by it, the steady decay of its powers after removal from the radium, and the growth of new emanation by the radium, kept, let us say, in another building or another country; then the radium emanation passes from being a phrase to a fact which no theory can safely ignore. The same is equally true of thorium X, radium C, and the numerous other successive products of radio-active change.

It would be a pity if the public were misled into supposing that those who have not worked with radio-active bodies are as entitled to as weighty an opinion as those who have. The latter are talking of facts they know, the former frequently of terms they have read of. If, as a result of the recent controversy, it has been made clear that atomic disintegration is based on experimental evidence, which even its most hostile opponents are unable to shake or explain in any other way, the best ends of science will have been served. The sooner this is understood the better, for in radio-activity we have but a foretaste of a fountain of new knowledge, destined to overflow the boundaries of science and to impregnate with teeming thought many a high and arid plateau of philosophy.

F. SODDY.

THE MYSTERIES OF LHASA.[1]

THIS is a new and cheaper edition of Colonel Waddell's account of our recent expedition into Tibet. In its more expensive shape it passed through two editions, and the present one is a marvel of cheapness. Not very many of the illustrations in the issue of last year are omitted in this year's reprint, and the type is the same, so much so, indeed, that it has not been considered necessary to remove from the letterpress references to photographs that have not been reproduced (see, for instance, pp. 369, 374, 409, and 411). It is not often that one can buy a handsomely printed book of 550 pages, with more than 150 illustrations, eight excellent maps and plans, and a very good index for a few shillings.

One of the most alluring things about the book is its title. The contents bear out this title only to a limited extent. It is true that we have here a description of Lhasa and its sights of much the same kind as a guide-book would give of a European city and its sights; but not much of this is very new. We have had descriptions, and even photographs, of Lhasa and its palaces before. What people mean when they speak of the mysteries of the place may include this, but it refers in the main to something very different. The author is well aware of this. He refers in his preface to the curiosity stimulated by the belief that somewhere behind the mighty Kanchenjunga there would be found a key to unlock the mysteries of the world; and the belief in the possibility of this is widely diffused.

The ball was set rolling, though this is not generally known, by the famous Earl of Chesterfield, the author of the well-known letters to his son. This was done in another work of his entitled "The Economy of Human Life," published in 1751. Unwilling at that date to give his views of life and religion under his own name, he wrote anonymously; and the method he adopted was to prefix to his book an elaborate introduction, in which he describes Lhasa, its palaces and its libraries, tells us how the Emperor of China, fully convinced that there could be found in those libraries ancient books of wisdom, sent a learned minister, "of a grave and noble aspect," and armed with an autograph letter from the Emperor to the Grand Lama, to discover them; tells us further how the minister found many "curious pieces of antiquity," and how the most ancient of them all was precisely the original of this "Economy of Human Life"; and finally explains the very curious ways in which this ancient MS. was translated, and then sent to him, who now gives it to the world. It is all very well done—as romance; but it was taken in sober earnest. The book went through more than fifty editions, and has been often translated. No one seems to have divined, until last year, that it was merely an English book of the eighteenth century. The editor of the last English edition (1902) still speaks of it as "this ancient wisdom"; and its great success led to no less famous imitations purporting to be the work of the so-called Mahatmas of Tibet. On these interesting delusions the author merely states that inquiries of learned Tibetans he happened to meet with, and such cursory examination as was possible of the libraries passed on the road, led to no result. Such negative evidence is not of much value. He might have added that the mystery is not in Tibet at all, but in certain phases of European thought.

In this connection it is noteworthy that Colonel

[1] "Lhasa and its Mysteries, with a Record of the Expedition of 1903-4." By L. A. Waddell, LL.D., C.B., Lieut.-Col. Indian Medical Service. Third Edition. Pp. xx+530. (London: Methuen and Co., 1906.) Price 7s. 6d. net.

Waddell gives us the translation of a Tibetan prophecy, copied by himself a year before our expedition was heard of, and that he adds:—"How the astrologers of Tibet were able to predict this distressful storm which was in store for their country, so long before it happened, and to specify that it should occur in this very year, is amazing." This is good evidence, not, indeed, of any mystic power in Tibet, but that the astrologers there know the tricks of their trade as well as any Zadkiel. The prediction is beautifully vague. A Chinese or a Russian *coup d'état*, or a civil war, would have suited it equally well, but it was apparently designed to fit some internal commotion. From what Colonel Waddell tells us of the headstrong character of the Grand Lama, and of the cabals and intrigues at Lhasa, that was a highly probable event.

The volume is really a very readable and clear account of the British invasion of Tibet. To that, eighteen chapters out of twenty-three are devoted, the others being a popular introduction on the history of Tibet and descriptions of Gyantse and Lhasa. The account of the expedition, which thus makes up the bulk of the book, is most interesting. The expedition seems to have been excellently planned and excellently carried out; but no serious opposition was offered until too late, and the desperate bravery of the hastily raised Tibetan peasantry, badly armed and badly led, was no match for the highly trained troops of the little English army, with its superior organisation, guns, and generalship. Only on two occasions did there seem any possibility of even temporary disaster for the invaders. The description of these two anxious moments makes exciting reading, and is quite in the style of the best war correspondents.

In what is told us of Lamaism in Tibet, on the other hand, it seems a pity that Colonel Waddell scarcely does himself justice. We have some interesting and sometimes (no doubt quite justifiably) pungent remarks on the Lamaist system as seen from the outside—the squalor, dirt, and ignorance of the poor, the intrigues and cruelties of the Government, the backward state of trade and agriculture, the decline in population, and so on. We have accounts of the services in the churches, of the images, of the roadside texts, of the appearance of the monasteries, and of one curious hermitage and its ghastly inmates; but of the inner meaning of the religion, the central truths, or what are held as truths, which give to all these outward matters a meaning, which at one time at least must have afforded strength and vitality to the system, we learn little or nothing. Some passages translated from the Litany (pp. 403–4) have both poetic beauty and religious feeling. Perhaps this may be partly due to Colonel Waddell's fine translation; but the absence of anything either superstitious or childish is striking. The texts on the wayside, put up for the edification of passers by (p. 210), are good, sound sense. Both of these, and they are the only passages quoted, seem at utter variance with the kind of tone and spirit described as animating the Lamas. The mystic spell, as it is called on p. 29, *Om! Mani padme. Hung!* is there translated "Hail! Jewel in the Lotus flower!" and reference is made to the figure of the Spirit of the Mountains on p. 23; but that figure represents the god, not as in, but as standing on the top of, a lotus, and the expression seems to us odd and forced if it really conveys that sense. Why should the Spirit of the Mountains be called the jewel in the lotus? The lotus is not a mountain flower. This at least requires explanation, and Colonel Waddell, as a Tibetan and

Camp under Nojin Glacier in Kharo Pass, 16,200 feet. From "Lhasa and its Mysteries."

Buddhist scholar, might, no doubt, had he wished to do so, have quoted a passage from some work held in authority in Tibet giving the explanation required.

There is a charming report in one of the closing chapters of an interview the author had with Gahldan Cardinal, who had been appointed Regent by the Dalai Lama on the eve of his flight. He is described as a man of striking presence, as one of the most learned and profound scholars in Tibet, and at the same time as a man of strong character and skilled in affairs. There are evidently some Lamas who read their books: and though their views and ours may be altogether different, there can be little doubt but that we also, if they were only made accessible by good translations, should find in them valuable materials for the history of that Eastern culture which it is day by day becoming more and more important for us to understand. We are gratified to hear that the able writer of this delightful book is intending to devote the whole of his time in future to these studies; and we trust that he will succeed in unravelling for us some more, and deeper, mysteries of Lhasa.

MINING GEOLOGY.[1]

THE literature of economic geology is by no means inconsiderable, for since the publication in 1884 of John Arthur Phillips's classic work on ore deposits, much attention has been devoted to the study of mineral deposits, and in the United States, in particular, theories of the formation of such deposits have been propounded with bewildering frequency. Prof. Park's text-book under notice, which covers the ground that is gone over in the elementary course in the subject at the University of Dunedin, New Zealand, will, therefore, undoubtedly prove useful to the mining student.

The author deals with the subject in nine chapters. The first contains a brief summary of geological principles, and the following chapters are devoted respectively to the classification of mineral deposits, ore veins, the dynamics of lodes and beds, ore deposits considered genetically, the theories of vein formation, ores and minerals considered economically, mine sampling, and the examination and valuation of mines. The chapter dealing with the genesis of ore deposits is of special interest. The perplexing problems by which the subject is surrounded are judicially dealt with. The fascinating theory of lateral secretion to which great support was given by Sandberger's brilliant researches, although strongly opposed by Prof. Stelzner, of Freiberg, and by Prof. Posepny, of Przibram, found much support in America in a more or less modified form. Posepny's ascension hypothesis has not been endorsed by succeeding investigators in its integrity, and American geologists have gradually developed a conception lying somewhere between the theories of Sandberger and Posepny, with a distinct leaning towards the teachings of the latter. The mode of formation of mineral veins is, however, still very far indeed from being understood. The facts recorded by Prof. Park appear to show that the majority of ore deposits are genetically connected with igneous intrusions which may be plutonic or volcanic. Circulating underground waters and gases are the principal agents concerned in the dissolution, primary concentration, and deposition of vein matter. Ore deposits do not necessarily occupy pre-existing fissures and cavities. Vein-filling was in many cases effected by metasomatic replacement. Vein-filling waters are ascending waters, but not necessarily deep-seated. The mineral contents are derived from rocks contiguous to the zone of fracture or zone of metamorphism. The accessory agents of dissolution are heat and pressure, aided by dissolved alkaline minerals. Precipitation from the ascending waters takes place in more or less orderly horizontal zones in accordance with the laws governing solution and precipitation. Lastly, secondary enrichment is, in the majority of cases, due to the migration of mineral contents from a higher to a lower level, through the agency of descending waters.

Geyser crater at Whakarewarewa, New Zealand, showing siliceous crustification. From "A Text-book of Mining Geology."

Some interesting observations on the action of ascending alkaline waters in New Zealand are recorded by the author. Around Lake Rotorua ore deposits of the solfataric class can be seen still in process of formation on a scale of considerable magnitude. At the hot springs the sinter encrusting the walls of the fissures and pipes from which the waters escape at the surface is hard and chalcedonic, and arranged in layers which often present a fine, ribbon-like structure.

[1] "A Text-book of Mining Geology." By James Park. Pp. ix+219, with 78 illustrations and 3 plates. (London: Charles Griffin and Co., Ltd., 1906.) Price 6s.

A striking illustration showing this siliceous crustification at the geyser crater at Whakarewarewa, New Zealand, is given by the author. Hand specimens of the harder sinters cannot be distinguished from much of the ore at the outcrop of the Martha lode at Waihi. In places the sinters contain finely disseminated marcasite and traces of gold and silver.

NOTES.

A SHORT time ago a petition was presented to the Dean of Westminster asking permission to place in Westminster Abbey a memorial tablet commemorating the life and influence of Mr. Herbert Spencer, but though the appeal was supported by many men of science and letters it was rejected. The reason why the Dean withheld his consent to this unobtrusive memorial of a great philosopher is not clear; and the *Daily Chronicle* has recently revived interest in the movement with the object of inducing him to reconsider his decision, or, failing this, to secure some other national memorial of Spencer's work. From the opinions of a number of distinguished men published in our contemporary, it is evident that much disappointment is felt at the failure to find a place in the Abbey for a simple memorial tablet to Spencer, but there is a difference of opinion as to whether steps should be taken to establish a national memorial to him in some other form. Among the men of science who consider it would be a reproach to leave Spencer's memory unhonoured are Lord Avebury, Prof. Clifford Allbutt, Dr. Bastian, Sir Michael Foster, Mr. Francis Galton, Sir Joseph Hooker, Prof. M'Kendrick, and Prof. Poulton. There is, however, a strong feeling, expressed by Sir Norman Lockyer, that while no national memorial to Darwin exists outside Westminster Abbey, it would be undesirable to attempt to raise one to Spencer by public subscription. Lord Kelvin goes so far as to remark:—"I have never been of opinion that the philosophical writings of the late Mr. Herbert Spencer had the value or importance which has been attributed to them by many readers of high distinction. In my opinion, a national memorial would be unsuitable." Sir William Huggins also hesitates to support a general movement to provide a national memorial, though he agrees that a memorial tablet in the Abbey would appropriately commemorate Spencer's work. In the absence of this form of recognition, it would seem that the best way for admirers of the philosopher to show their appreciation of his work would be to establish a lectureship or scholarship in sociology, natural science, or principles of education, to issue, as suggested by Dr. A. R. Wallace, a cheap edition of his works, or in some other manner to further the objects to which he devoted his life. A movement with an end of this kind in view might be made of international interest, and would doubtless receive liberal support.

THE King has appointed a Royal Commission "To inquire into and report upon the practice of subjecting live animals to experiments, whether by vivisection or otherwise; and also to inquire into the law relating to that practice, and its administration; and to report whether any, and if so what, changes are desirable." The members of the commission are:—Viscount Selby (chairman), Colonel A. M. Lockwood, M.P., Sir W. S. Church, Bart., K.C.B., Sir W. J. Collins, M.P., Sir J. McFadyean, Mr. M. D. Chalmers, C.B., Mr. A. J. Ram, K.C., Dr. W. H. Gaskell, F.R.S., Mr. J. Tomkinson, M.P., and Dr. G. Wilson, with Captain C. Bigham, C.M.G. (secretary). The offices of the commission, which will not sit until toward the end of October, will be at Chapel Place, Delahay Street, S.W.

THE Engineering and Machinery Exhibition, which was opened at Olympia on Saturday by Sir Alexander Binnie, president of the Institution of Civil Engineers, is of wide scope, and contains a fine display of British machinery. Some interesting exhibits have also been sent by American and Continental firms. The most striking feature is an electric fountain and air circulator, which occupies the centre of the hall. It is the invention of Mr. James Keith. The fountain is 33 feet in height, and it is surrounded by a shell 15 feet in diameter. In the pedestal beneath are six large electric fans, and air is drawn in from the ground-level, washed, cooled, and re-circulated at the rate of 22,000 cubic feet of air per minute. The illuminations connected with the fountain are brilliantly effective. Numerous other interesting novelties are shown, and the display of machine tools is particularly good. At the luncheon following the opening ceremony, Sir William White, president of the exhibition, pointed out that the basis of the exhibition was mechanical engineering, which was maid-of-all-work to all other branches of engineering. The exhibition was no common enterprise, and the public could not fail to be impressed by the extraordinary variety of machinery applied to the needs of modern life, but also by the keen competition going on in the mechanical industries all over the world. Mr. Bennett Brough, who proposed the toast of the visitors, and Prof. Silvanus Thompson, who replied, also testified to the great value of the exhibition. Special facilities are being afforded to students to visit the exhibition, and an excellent course of popular lectures has been arranged. The exhibition will remain open for a month.

THE death is announced of Dr. H. Cohn, extraordinary professor of diseases of the eyes in the University of Breslau, distinguished by his studies in school hygiene.

THE new Japanese pharmacopœia is to be published shortly. The names of all drugs and chemicals will be given in Japanese characters only. Foreign preparations which have been patented under fancy names will be excluded.

IT is reported from Hong Kong that at 10 a.m. on Tuesday, September 18, a typhoon which sprang up there caused enormous damage to shipping and great loss of life. The storm lasted for two hours.

THE death is announced of Dr. Morache, professor of medical jurisprudence in the Bordeaux Medical Faculty; and of Prof. Leon Prunier, director of the Pharmacie centrale des Hôpitaux civils in Paris, at the age of sixty-five. Prunier's scientific work touched upon many branches of chemistry; his book "Les Medicaments chimiques" (in two volumes) was a recognised treatise in France.

THE Association des Industriels de France contre les Accidents du Travail intends offering a prize of 8000 francs for an international competition for a new galvanic battery or accumulator which, while having a large output for its size and weight, must not be dangerous in use. Inquiries should be addressed to the director of the society, rue de Lutèce, Paris, who will supply further particulars, and to whom competitors must send their descriptions and drawings.

A COMPLETE change of weather set in during the past week, and the drought which continued with such persistence during the closing week of August and the first

fortnight of September was at length thoroughly broken. Rain fell on several days over the entire country, and the rainfall in the aggregate now almost equals the average for the month in many parts of England. Temperatures are again in agreement with the normal, and in the past week the exposed thermometer at Greenwich fell below the freezing point on two consecutive nights.

THE fifth biennial meeting of the International Commission for Scientific Aëronautics will be held this year at Milan, from September 30 to October 7. A programme for continuing the meteorological exploration of the atmosphere will be adopted (says *Science*), and it is expected that the president of the commission, Prof. Hergesell, will state the results of soundings of the atmosphere, which he has just executed near Spitsbergen from the Prince of Monaco's yacht, and that Messrs. Teisserenc de Bort and Rotch will give an account of the second Franco-American expedition which they sent last winter to the tropical Atlantic for a similar purpose.

WE learn from the *Times* that the arrangements for the international balloon race which is to take place on September 30 have been completed. Sixteen balloons will be employed in the race, and the aëronauts will represent Great Britain, France, Germany, America, Italy, Belgium, and Spain. The arrangements for the race have been made by the Aéro Club of France, and the start will be made from the Place de la Concorde, Paris. The moving spirit in the contest is Mr. Gordon Bennett, who offers a challenge cup, value 500*l.*, and 500*l.* in cash for the winner. The prizes will be awarded to the aëronaut who goes the furthest distance. The longest distance yet made in any of these expeditions has been 1200 miles, from Paris to Kieff, in Russia, but it is possible that under favourable conditions that record may be broken.

A CONFERENCE of members of the Museums Association and others interested in museum work will be held at Chester on Saturday afternoon, September 22, for the purpose of discussing subjects of common interest to those concerned in the work of museums, art galleries, and kindred institutions. The following papers will be read and discussed:—The nature of the archæological collections in the Grosvenor Museum, Chester, R. Newstead; the nature of the natural history collections in the Grosvenor Museum, Chester, A. Newstead; the comparative method in the exhibition of museum specimens, J. A. Clubb; museum taxidermy, and the status of the taxidermist, J. W. Cutmore.

THE Hull Municipal Museum recently purchased the extensive geological collection formed by the late Mr. George Lether, of Scarborough. Mr. Lether was well known as an enthusiastic collector, and for many years he was engaged in making a collection of the smaller species to be found in the fossiliferous deposits which are so well represented around Scarborough. The Kelloways Rock, Calcareous Grit, Coral Rag, Cornbrash, the Millepore limestone and Scarborough limestone were well known to him, and from these various strata he obtained the collection now at Hull. It is particularly strong in the smaller gasteropods, but in addition contains a fine series of sea-urchins, terebratulæ, ammonites, corals, &c. The collection is one of exceptional value, and is a welcome addition to the local geological collection in the Hull Museum.

REPORTS of disturbances in the earth's crust continue to be received. During the past few days the following shocks of a severe character have been felt:—*September* 12, Santiago de Chile. Between 1.20 a.m. and 5 p.m. numerous earthquake shocks were felt in the region situated between the provinces of Santiago and Maule. The shocks are attributed to the Chillan volcano, which is in full activity. Near the mouth of the Bio-Bio River an upheaval has been produced, leaving part of the bed of the river dry. *September* 13, Sicily.—At 10.43 a.m. a slight shock of earthquake was felt at Palermo, and was succeeded by other shocks later. The inhabitants at Termini and in the neighbouring district are in an indescribable state of panic. All the houses in Trabia are cracked, and many have collapsed. Slight shocks were felt at Rioja, Chilecito, and Santiago del Estero. A more violent shock occurred at Tinogasta, followed by loud rumbling. *September* 17, Shemakha, Transcaucasia.—An earthquake, lasting ten seconds, was felt at 3 p.m. The disturbance appeared to move in a direction from north-west to south-east.

THE subject of malaria in Greece was dealt with by Prof. Ronald Ross, F.R.S., on Monday, in the course of an address at a luncheon given at Liverpool to Prof. Savas, of the University of Athens. Prof. Ross said that at the request of the Lake Copias Company (Limited) the Liverpool School of Tropical Medicine had made an investigation as to the prevalence of malaria in Greece. He went out to that country last May, and found a very serious state of affairs. The population was practically confined to the valleys, the mountains being almost uninhabitable, and in these valleys he found a good deal of malaria. The statistics of the whole country showed that out of a population of, roughly, 2½ millions, there were 250,000 cases of malaria every year, and the deaths were about 1760. Last year the number of cases increased to 960,000, and the deaths to 5916. He was of opinion that it was malaria which checked the life of ancient Greece, and that the disease was introduced, or at all events reinforced, at the time that Greece brought natives of Asia into the country. The movement initiated by Dr. Savas to deal with the plague was one which should recommend itself to all interested in the progress of civilisation.

A DETAILED description is given in the *Engineer* (vol. cii., No. 2644) of some interesting models of rock-drilling and boring machinery that have been added to the cases devoted to this branch of mechanics at the Victoria and Albert Museum.

AN interesting incident of a sparrow caught in a spider's web is reported to the *Spectator* of September 8 by Mr. B. G. Tours, writing from the British Consulate in Chinkiang, China. The web was built across a brick arch, and the sparrow, a full-grown bird, flying through it head downwards became caught in it. All its efforts to release itself only served to add to its discomfort, and the bird soon became exhausted and gave up struggling. Mr. Tours then released it, and he adds that it was "looking and evidently being very uncomfortable in his extra clothes of cobweb." During the whole proceeding the very large spider had not attempted to interfere with the bird, and would probably have waited until it was dead before doing so.

IN *Engineering* of September 14 there is a long description, and a large number of excellent illustrations, of the quadruple-screw steam-turbine-driven 25-knot Cunard liner *Mauretania*, to be launched on September 20 from the Wallsend shipyard. The following are the dimensions of

the vessel:—length over all, 785 feet; length between perpendiculars, 760 feet; beam, extreme, 88 feet; depth, moulded, 60 feet 6 inches; gross tonnage, 33,200 tons; net tonnage, 11,900 tons; maximum draught, 37 feet; displacement at this draught, 43,000 tons. The *Mauretania* is 160 feet longer than the *Campania*, of 1893, 78 feet 6 inches longer than the fastest of existing ships—the *Kaiser Wilhelm II.*—and 80 feet longer than the *Great Eastern*, the greatest of preceding vessels.

In Cornwall at the present time, owing to the high price of metals, there is great activity in copper and tin mining, and it is interesting to note, in an important article in the *Times* of September 17, the extent to which scientific methods and the latest improvements in appliances are being adopted at the newly started mines. At the Tywarnhaile mine, for example, with the aid of a gas-power plant and electric pumps, the workings have been drained at the rate of 1400 gallons a minute. This speed has never been approached in the past history of Cornish mines. At the Great Dowgas tin mines, pneumatic stamps will for the first time be driven direct by gas power, and winding and pumping will be electrical. At the Alfred mines a central gas-power plant has also been installed. When work was resumed at the Clitters mine some five years ago, those responsible formed the opinion that the costs of working mines in Cornwall were far too high; that values existed in mixed ores far beyond the knowledge of those then concerned in mining and dressing such ores; and that great improvements in mining and dressing methods were possible. It has been proved that these impressions were true, and future developments in the application of modern scientific methods to the ancient Cornish mines cannot fail to be watched with interest.

The seventeenth annual general meeting of the Institution of Mining Engineers, held at Hanley on September 12–14 under the presidency of Sir Lees Knowles, was very largely attended, and an interesting programme of visits and excursions was arranged. The report of the council showed that the membership of the institution now amounts to 3034. Mr. Maurice Deacon (Chesterfield) was elected president for the ensuing year. Three papers were read. Mr. W. D. Verschoyle described a new pocket transit, which was really a combined prismatic compass and clinometer, ingeniously arranged for observing very steep angles. Mr. T. Trafford Wynne gave a detailed description of the gypsum deposits of the Dove Valley. The discussion on this paper was well sustained. Mr. Bennett H. Brough pointed out that the author in his introductory sketch of the occurrence of gypsum had omitted to refer to the Paris deposits, which produced two-thirds of the world's supply. The speaker suggested that there was considerable room for improvement in the manufacture of plaster of Paris. Scientific progress had hardly touched the technology of this material, and the temperature of burning and the degree of fineness received no attention. The methods of testing gypsum were now to be investigated by a committee of the International Testing Congress. The charge of want of progress was warmly combated by other speakers, who adduced evidence to show the high degree of scientific method followed in several plaster works in this country. In conclusion, a paper was read by Mr. E. B. Wain and Mr. J. T. Stobbs on the Cauldon Low and Manifold Valley, North Staffordshire, a district of considerable geological interest, in which a large quarry of Carboniferous limestone of very pure quality is worked, and where at one time the famous Ecton copper mine was of great importance.

The liverworts of Japan have attracted the attention of bryologists on account of the special peculiarities of certain species referable to well-known genera. Mr. A. W. Evans describes and figures a few new or interesting species, mostly collected in the province of Tosa, in vol. viii. of the Proceedings of the Washington Academy of Sciences. A species of Harpalejeunia is interesting as forming a link between that genus and Drepanolejeunia.

Tracing the development of the State Forest Department in West Prussia, Dr. Koenig attributes the foundation of the present system to the personal interest and direction of Frederick the Great. With regard to the extent of forest, the writer is disposed to believe that more land might with advantage be afforested, notably the sandy and other unprofitable areas, provided the land were acquired by the State. The article appears in *Schriften der naturforschenden Gesellschaft* in Danzig, vol. ii., part iv.

In the *Indian Forester* (July) the editorial article bears testimony to the foresight of the present Commander-in-Chief in India in demanding the preparation of working plans for cantonment forests in India, and summarises a similar scheme drafted by the United States Forest Service for the Military Department for a forest reservation at the military academy army post at West Point, New York. Following on previous references to types of forest rest-houses in India, Mr. E. P. Stebbing deals with those met with in Assam, that from descriptions and illustrations are no more satisfactory than those provided in Burma.

With reference to the maintenance of the Imperial Department of Agriculture in the West Indies, an editorial notice appears in *Tropical Life* on the work of botanical and experimental stations. It is appropriate to find in the same number a biography of Dr. J. C. Willis, who has done so much towards bringing the agricultural community in Ceylon into its present prosperous condition. A note on the camphor industry contains a description of the Formosan method of distillation, and the opinion is expressed that the present price of camphor could be reduced to one-third or less before the Formosan monopoly would be endangered.

The *Museums Journal* for August is entirely occupied with the report of the recent conference at Bristol and an illustrated account and history of the museum buildings of that city. In the latter, the development of the museum and art-gallery is carefully recorded by Mr. W. R. Bacher during a period approaching a century and a half—1772–1906. It is well known that the Bristol Museum possesses a number of natural history treasures, among them an example of the typical southern race of the bonte-quagga, or Burchell's zebra, now apparently extinct, and unrepresented in the national collection.

In the twenty-first Educational Leaflet, dealing with the scarlet tanager, the U.S. National Association of Audubon Societies (as represented by its president, Mr. W. Dutcher) strikes an important note in asserting that its objects are not limited to the protection of birds, but embrace the awakening of an interest on the part of the agriculturist (as well as the student) in bird-life generally. Undoubtedly this is the right way of looking at the subject, and if it were inculcated and adopted in this country (together with some relaxation of the law in regard to species held to be harmful by practical people), we should probably hear fewer objections to bird protection. The coloured plate shows the male and female tanagers in their respective

liveries of black and scarlet and greenish-yellow, and also the cock bird in process of reverting for the winter to the comparatively dull plumage of his mate.

IN an article entitled "The Negro Brain," published in the September issue of the *Century Illustrated Monthly Magazine*, Dr. R. B. Bean rejects the doctrine that the negro is the brother of the white man. After demonstrating that the male Caucasian brain is not only larger than that of the negro, but also differs in shape and by the smaller proportionate amount of grey matter and of connecting fibres, the author sums up as follows:—"The white and the black races are antipodal in cardinal points. The one has a large frontal region of the brain, the other a larger region behind; the one is a great reasoner, the other preeminently emotional; the one domineering, but having great self-control, the other meek and submissive, but violent and lacking self-control when the passions are aroused; the one a very advanced race, the other a very backward one. The Caucasian and the negro are fundamentally opposite extremes in evolution." These premises being admitted, it is clear (despite the fact that a negro may occasionally display exceptional mental powers) that to attempt to educate the two races on the same lines is neither more nor less than folly. Incidentally, the author shows that the American negro, in place of being entirely of the Guinea type, includes representatives of the Bushman and of the Bantu (Kafir) types.

IN *Canary and Cage-bird Life* for August 31 Dr. A. R. Galloway records a case of cross-breeding in poultry which well exemplifies the Mendelian law. The two breeds crossed were the silkie bantam and the Pekin bantam, the former characterised by the pure white hair-like plumage, bluish-black skin, and small rose comb and crest, while the latter has the plumage cinnamon-buff, the skin pinkish, and the comb simple. Four years ago, when a silkie cock was mated with a Pekin hen, the hybrid chicks—between twenty and thirty in number—were all buff, although with a tendency to small dark markings. Nevertheless, the buff may be regarded as the dominant colour in the cross, but in the hens, at any rate, the black skin and small rose comb and crest of the silkie were apparent. During the present summer a first-cross buff cock paired with a buff hen of the same cross, and, of the eight chicks thus produced, one was a pure white silkie, two were pure buff Pekins, and five showed intermediate characters with regard to type, colour of skin, and colour and character of feather. This is a close approximation, considering the limited nature of the trial, to Mendel's law, which should give two pure silkies, four intermediates, and two buff Pekins. The five intermediates were as follows:—one a buff Pekin with blackish face and silkie-type of feather; one buff Pekin with blackish face and two or three quills white in each wing; one variegated buff Pekin showing about one-third of plumage white, with Pekin-type of face and silkie-feathers; two dark speckled grey, with blackish faces and a good deal of black markings on the feathers.

SOME curious results of the Californian earthquake are recorded by Prof. Campbell, director of the Lick Observatory, in No. 108 of the Publications of the Astronomical Society of the Pacific. Fortunately, as recorded in these columns on May 10, the observatory itself was not injured. Subsequent work has shown that the meridian circle and the polar axis of the 36-inch refractor show no sign of having shifted. The period of the earth vibrations was so long that the buildings and the instrument foundations had time to follow the movement without undue strain. There is some fear, however, that the financial affairs of the university and the observatory may be somewhat crippled by the huge losses incurred in property, &c. It is evident from the report that the neighbourhood suffered severely. The motion was chiefly of the horizontal shearing type, and we read of a public road which crossed the fault-line at right angles having its contiguous ends permanently displaced some 17 feet. A large tree standing on the edge of the fissure is 24 feet from the small roots it left behind it. A barn which stood exactly over the fissure, with some four-fifths of the structure on the west side, was badly wrecked, but the part of the foundations and superstructure situated on the west side remain, whilst the foundation lying east of the fissure has moved southward, under the barn, through 18 feet. Many similar instances of movement are recorded. About twenty miles westward of Mount Hamilton, on the fault-line, the maximum shift is about 8½ feet. As all the displacements referred to are in thick, loamy soil, which would tend to lag, it is probable that the shear in the underlying rock stratum is still greater. Some interesting questions as to farm boundaries, latitudes, and azimuths may be expected to arise. A commission, including Profs. Campbell and Leuschner, has been appointed by the Governor to study the scientific aspects of the phenomenon.

IN a letter from Glasgow, Mr. A. Mclance suggests that lead should be found in radio-active minerals containing radium. In a paper by Mr. Boltwood in the *Philosophical Magazine* for April, 1905 (p. 613), evidence is given of the existence of lead in all radio-active minerals. Mr. Mclance points out that if the atomic weight of radium is taken as 258, as found from spectroscopic observations by Runge and Precht, and the combined atomic weights of the five helium atoms into which the radium atom is believed to dissociate are subtracted from it, the atomic weight of uranium is obtained.

A SUMPTUOUS catalogue of telescopes and accessories has been published by the firm of Carl Zeiss, of Jena, under the specific designation "Astro: 8." Especially compiled for scientific amateur astronomers, the catalogue only deals with telescopes of less aperture than 8 inches. Several new constructions are now catalogued and illustrated for the first time. In addition to the numerous azimuthal and equatorial telescopes, the catalogue contains illustrations and prices of a large variety of eye-pieces, sun oculars, prominence and other spectroscopes, position micrometers, the stereo-comparator, &c., and should be consulted by all astronomers in need of telescopes or accessories.

IN No. 72 of the *Chemiker Zeitung* Dr. P. N. Raikow, of the University of Sophia, describes a simple method of boring any number of small holes through glass tubing, both thin and thick, watch glasses, flasks, &c. The part which it is desired to pierce is carefully warmed up in a Bunsen flame, and then a red-hot needle worked bradawl-wise against the particular spot, which naturally must not be so hot that any slight pressure causes the walls of the vessel or tube to be forced out of shape. The broken stem of a thermometer is said to provide an especially good handle for the eye end of the needle to be inserted into.

OUR ASTRONOMICAL COLUMN.

JUPITER'S SIXTH SATELLITE.—A telegram from Prof. Campbell, published in No. 4119 of the *Astronomische Nachrichten*, states that Jupiter's sixth satellite was re-observed by its discoverer, Prof. Perrine, on August 26·96570 (G.M.T.). Its position angle at that time was 209°·92, and its distance from Jupiter 1734″.

HOLMES'S COMET (1906*f*).—In No. 4121 of the *Astronomische Nachrichten* Prof. Max Wolf states that he has measured the position of Holmes's comet on the plate secured on August 28. He gives the exact position, for 1906·0, at the time of discovery, and this shows that corrections of +6·79s. and +28″·2 are necessary to Dr. Zwiers's ephemeris. As the comet is extremely faint, mag. = 15·5, a continuation of the ephemeris is not given here, but will be found in No. 4085 of the *Astronomische Nachrichten*.

OBSERVATIONS OF SOLAR PHENOMENA, 1906.—The results of the observations of sun-spots, faculæ, and prominences made during the first semester of the present year at the Catania Observatory are published by Prof. Mascari in No. 8, vol. xxxv., of the *Memorie della Società degli Spettroscopisti Italiani*.

The mean daily frequency of spots was higher during the second than during the first quarter, the respective numbers being 5·68 and 4·50; the faculæ behaved similarly. For prominences the reverse was the case, there being a mean daily frequency of 4·38 prominences during the first quarter and 3·47 during the second. Discussing the results in relation to the time of the solar maximum, Prof. Mascari places the epoch of maximum spots at 1905·2, and that of faculæ and prominences in the last quarter of 1905 or the first quarter of 1906.

OBSERVATIONS OF JUPITER.—The observations of Jupiter made by Mr. Denning during the last opposition showed that the rotation period of the Great Red Spot and its Hollow, in the south equatorial belt, between March 24 and May 4, was 9h. 55m. 40·6s., a period practically conformable with that of system ii. of the ephemerides. On observing the phenomena on August 9, however, he found that they were far in advance of their predicted places, an observation confirmed by the Rev. T. E. R. Phillips. From this it appears that the rotation period between May 4 and August 8 was only 9h. 55m. 33·8s. Mr. Denning supposes that the conjunction of the dark material, forming the south tropical disturbance, with the Red Spot, in June last, may have caused the marked acceleration of the latter, as it has done on several former occasions. The present increase of velocity is, however, much greater than any previously observed, and these features appear to have been observable for seventy-five years (the *Observatory*, No. 374).

In the September number of the *Bulletin de la Société astronomique de France* M. Flammarion directs attention to a remarkably sudden change in the visibility of the north equatorial band on Jupiter. This band has been diminishing since the end of 1903, and an observation made by M. Benoit, at Juvisy, on April 10, 1906, showed that it was almost completely invisible. After its conjunction with the sun, Jupiter was observed again on July 17 by M. Quenisset, who was astonished to find that the north equatorial band was completely reformed, being even broader, and at some points darker, than the south equatorial band. A drawing, made by M. Quenisset on July 23, is reproduced with the article.

THE KODAIKANAL OBSERVATORY.—An interesting popular account of India's solar physics observatory, situated at Kodaikanal, on the Palani Hills, appears in the July number of the *Madras Christian College Magazine*. Mr. Monteith Macphail, the writer of the account, lately visited the observatory, and was evidently impressed with its situation and its work. The altitude of the observatory is about 7700 feet, in an atmosphere of exceptional transparency, and amid beautiful surroundings.

Although located in Madras, the institution was founded, and is supported, by the Government of India, thus having a national and not merely a provincial status. Its chief *raison d'être* is the continuous study of the sun, with the ultimate idea of elucidating still further the indicated relationships between solar and terrestrial atmospheric phenomena. To a country like India, the value of possessing the fullest possible knowledge of these relationships cannot be overestimated, and that is the reason why the Government of India has seen fit to found and to support this observatory and its equipment in the most favourable situation at its command. Sun-spots, their spectra, and prominences on the solar limb, are observed visually, and spectroheliograms of the solar disc and limb are taken on every day on which the atmospheric conditions are suitable. Magnetical and seismological records are also taken.

CHEMISTRY AT THE BRITISH ASSOCIATION.

IT was somewhat noticeable that the trend of the proceedings in Section B this year was in the direction of applied chemistry; general problems on the theoretical side of the science came under discussion in Section A; if this indicate either that this section is becoming alive to the importance of chemistry to physics or a rapprochement of the two sections, it is a good sign, but it is not satisfactory if it mean the neglect of broad considerations by the chemist.

Reports were presented by Mr. S. S. Pickles, on the chemistry of rubber; on that of gums, by Mr. H. H. Robinson; and on the hydrolysis of sugars, by Mr. R. J. Caldwell. These gave rise to more or less interesting discussions and were a valuable feature of the meeting. Discussion also centred round a paper by Dr. T. A. Henry, on the production of hydrogen cyanide in plants. The joint discussion with the physiologists on diet was of great interest, although it was mainly developed in physiological and sociological directions.

The proceedings opened on the Thursday, August 2, with an important paper by Messrs. S. Leetham and Wm. Cramp, who have been engaged in perfecting an apparatus for the production of an active mixture of gases which may be used for bleaching and sterilising purposes, particularly in bleaching flour. The apparatus consists of an alternator, transformer, ozoniser and spark box, the two latter being in series on the high-tension side of the transformer; on passing a current of air through the ozoniser and then through the spark box a gaseous mixture is produced, containing minute amounts of ozone and oxides of nitrogen, which has a very remarkable bleaching and sterilising action on flour; the process is already one of considerable commercial value. The bleaching action appears to be an oxidation effect.

The authors have studied in great detail the behaviour of the different types of electric discharge and the influence of such factors as the number and distance apart of the discharge points, shape of the points, the air velocity and the frequency. The conclusion arrived at is that ozonisation is not a mere induction effect. In commenting on the paper, Prof. Armstrong dwelt on the importance of manufacturers taking interest in science, and referred to the work as an illustration of the advantages of such co-operation.

Following a short paper by Prof. van Romburgh, of Utrecht, on the 1 : 3 : 5-hexatrien, reports were read of the committees on dynamic isomerism, on hydro-aromatic substances and on aromatic nitro-amines. The rest of the morning was devoted to inorganic chemistry, papers being contributed by Mr. A. Vernon Harcourt, on the effect upon the concentration of a solution of the presence of an excess of undissolved salt; by Mr. G. Beilby, on the crystallisation of gold in the solid state; and by Prof. H. A. Miers and Miss F. Isaac, on the temperature at which water freezes in sealed tubes; this is found to be very considerably below that at which solidification takes place in open vessels.

The greater part of Friday, August 3, was devoted to a discussion on the production of hydrogen cyanide in plants, introduced by Prof. Dunstan, who pointed out that in the case of both *Lotus arabicus* and *Sorghum vulgare* the cyanide was formed only during the early stages of growth, and that it was missing in the mature plant. The fully-grown Lotus vetch is much used as a fodder plant in the Nile valley, but many fatal cases of poisoning have been caused through its use in the immature state. Hydrogen cyanide has also been detected in Java beans, of which there are several varieties; the maximum amount is found in the dark beans, and it is only safe to use the light bean. In the flax plant, which also affords hydrogen cyanide, the maximum amount is produced at an inter-

mediate stage when the plant is from 4 inches to 5 inches high.

Dr. Henry followed with an account of the glucosides containing the hydrogen cyanide, which have been grouped together as cyanogenetic glucosides. They are allied to amygdalin, the active principle in bitter almonds, which is therefore the oldest known representative of the group. The list at present comprises, besides amygdalin, sambunigrin, prulaurasin and a glucoside, prepared artificially from amygdalin by Fischer, known as mandelnitrileglucoside, all of which are resolved by acids into glucose, benzaldehyde and hydrogen cyanide; further, dhurrin, phaseolunatin, lotusin and gynocardin.

The plants containing these glucosides also contain enzymes, which resolve them—when the plant is macerated with water—into hydrogen cyanide, glucose and a third constituent. The question was raised as to the *rôle* of the hydrogen cyanide, whether it acted protectively or whether it played a part in the production of proteid from nitrates. Dr. Greshoff, of Harlem, dealt with the question from the botanical side, and put forward a list of all the species of plants known to yield hydrogen cyanide, which will be of great value to future workers.

A paper on the utilisation of atmospheric nitrogen by plants, read by Mr. Thomas Jamieson, described what the author regarded as special organs in plants adapted for the direct absorption and assimilation of nitrogen from the air. His conclusions were most severely criticised by Prof. Potter from the botanical side, and by Mr. A. D. Hall and others.

The report on caoutchouc, presented by Mr. S. S. Pickles, contained a general survey of the chemistry of this remarkable product.

Prof. Karl Harries, of Kiel, in a communication read by Dr. Crossley, dealt with the products obtained by submitting caoutchouc to the action of ozone, and then distilling the ozonide with steam, viz. lævulinic aldehyde, lævulinic acid and hydrogen peroxide. Harries concludes that caoutchouc is a polymer of a 1 : 5-dimethylcyclo-octadien. Prof. W. A. Tilden described his observations on the behaviour of isoprene, prepared from oil of turpentine; when kept it gradually polymerises, being converted into a substance having many of the properties of caoutchouc. He also contributed a paper on the constituents of *Dyera Costulata*.

Mr. H. H. Robinson followed with a brief account of the chemistry of gums, dwelling especially on gums from India and the colonies which afford acetic acid when exposed to the action of moist air. He suggested that by partially hydrolysing the inferior Indian gums they might be made of greater industrial value. In the subsequent discussion, Mr. S. H. Davies stated that constitution had so far been found to have little bearing on the technical value of gums, viscosity being the quality chiefly required.

In his report, Mr. R. J. Caldwell collected and critically discussed the literature bearing on the hydrolysis of sugars, a subject of considerable interest at the present moment on account of its bearing on the theory of ionic dissociation and the nature of solution. Nearly 150 papers have been published on the subject, so that it is very difficult for a new worker in the field to acquaint himself with the literature. Mr. Caldwell has made a brief abstract of the essential points in each paper, and classified them in historical order under a number of appropriate subheadings. He sums up the evidence as to the nature of the change, and points out the unsatisfactory character of the argument based on the dissociation hypothesis that it is brought about by the hydrogen ions of the acid. He is inclined to believe that the facts are to be explained by an association hypothesis.

A large part of the morning of Tuesday, August 7, was devoted to a joint discussion with Section I (physiology) on the factors which determine minimal diet values. This was opened by Dr. F. G. Hopkins, F.R.S.; Prof. Dunstan and Prof. Armstrong spoke on the chemical side. It was generally agreed that the subject was of supreme importance, and one that should be attacked conjointly by chemists and physiologists. Dr. Hopkins dealt chiefly with the standards of minimal diets put forward by Atwater, Voit and Chittenden respectively. These are incorporated in the following table:—

Investigator	Energy value in calories per diem	Protein per diem
Atwater	3500	125
Voit	3050	118
Chittenden	2600	55

The methods and results of these workers were considered and criticised in detail. While Atwater's standard was thought to be too high, it was generally agreed that Chittenden's values were too low. Voit's standard was accepted as the most probable.

Mr. Seebohm Rowntree's well-known experiments carried out in York were referred to, and it was pointed out that in studying actual dietaries of poor families averages were used in compiling statistics, a method which is open to criticism, as the bread-winner—owing to the self-denial of the woman—as a rule, gets far more than his share, so that the diet of the average working man is actually in most cases far richer in protein and has a greater energy value than is imagined.

Attention was directed by Dr. Hopkins—and this point was particularly emphasised by Prof. Armstrong—that it was not justifiable to consider merely the gross amount of protein, but that the nature of the protein had also to be taken into account. Thus, for example, wheat is probably not the best form of protein, its main constituent, glutaminic acid, being, so far as our present knowledge goes, of relatively little value as a tissue former compared with other amino-acids. Maize protein is perhaps of even lower value, whereas rice and oats, among the cereals, appear to be the especially valuable sources of protein. Prof. Armstrong particularly referred to the need of making detailed study of foodstuffs, our present method of referring to the nitrogen content generally multiplied by a factor as protein giving no true guide as to the relative value of foods, inasmuch as protein is a highly complex material, made of ever-varying units, the nutritive value of which taken singly varies within wide limits.

The rest of the morning was devoted to agricultural chemistry, Messrs. A. D. Hall and C. T. Gimingham contributing a paper on the action of ammonium salts upon clay and kindred substances, following which Dr. E. J. Russell read a communication by Dr. F. V. Darbishire and himself on oxidation in soils and its relation to productiveness. These authors have devised an apparatus for measuring the rate of absorption of oxygen; the power of absorbing this gas possessed by all soils appears to be due mainly, though not entirely, to the activity of micro-organisms. The rate of oxidation does not entirely depend on the amount of organic matter present in the soil; moisture is essential, and as it increases so also does the rate of oxidation. The rate is also increased by the addition of calcium carbonate or of sugar. For a series of similar soils, of which the cropping power is known, it is found that the most productive has the highest rate of oxidation, and that the others follow in the same order for both properties. The parallelism holds also for soils which have been artificially treated; it is essential, however, that the soil conditions should be aërobic. The authors suggest that the rate of oxidation affords a measure of the bacterial activity, which is closely connected with productiveness.

The last paper read was by Mr. W. Popplewell Bloxam, on a new method of determining indigotin. After pointing out the need of a method of controlling the still very crude processes in vogue for extracting indigo, and the importance of determining the daily yield of indigotin obtained in an ordinary factory from known weights of green plant, the existing methods of analysis were discussed and the uncertainty of the results they afford alluded to. In the author's method, the indigotin is sulphonated by treatment with fuming sulphuric acid (containing 20 per cent. sulphur trioxide); the solution is then diluted, and the potassium salt of indigotin tetrasulphonate precipitated by means of potassium acetate. Finally, the amount of indigotin in the salt is estimated by titration with potassium permanganate or titanium chloride. The author concludes that the present process of manufacture is a wasteful one, the highest efficiency attained not reaching 50 per cent., whilst on the average only 25 per cent. of the indigotin in the leaves is extracted.

THE PHYSICAL GEOGRAPHY OF VOLCANOES.[1]

IN my discourse this evening I shall confine myself to that branch of vulcanology to which I have paid particular attention, viz. the naked-eye study of volcanoes and their various constituent parts, their relations to one another and to adjacent rocks and to other objects; how they got to their present position and what effects they produce; in other words, the physiography or physical geography of volcanoes. As this subject is itself too large, I propose to take up the late eruption of Vesuvius, alluding to other volcanoes and their eruptions only by way of illustration, comparison, or contrast.

FIG. 1.—Vesuvius from Cook's Eremo Hotel near the Observatory, April 26, 1906. Shows the rounded top of the cone and the ash slides on it. Colle Umberto I° in the foreground.

The south-east side of the Bay of Naples, which consists of the Sorrento Peninsula and the island of Capri, is a branch of the Apennine Chain; it consists largely of Apennine limestone of Cretaceous age, and is not volcanic. The north-west side of the Bay, on the contrary, is almost entirely volcanic. Thus the island of Ischia is subject to severe earthquakes, and contains Monte Epomeo, which has been twice in active eruption in historic times; the islands of Procida and Nisida contain craters; the Phlegræan Fields consist of numerous cones and craters, one of which, Monte Nuovo, was formed as recently as the sixteenth century. Moreover, Naples itself is built on volcanic strata. The whole district is subject to changes of level.

Coming now to Vesuvius, it is a matter of common knowledge that it consists of twin mountains, of which one, Somma, is part of an old crater ring of gigantic size which no longer forms part of the working cone, which it partly surrounds, and from which it is separated by a great valley, called in different portions Atrio del Cavallo and Valle d'Inferno, while Vesuvius, the present active cone, occupies the southern part of the great crater which was formed by the destruction of that side of the Somma crater ring, probably in the Plinian eruption which destroyed Pompeii and Herculaneum in A.D. 79, or possibly in some earlier unrecorded eruption. The observatory is situated on a projecting spur forming part of the old Somma ring, but separated from that mountain by a deep valley, the Fossa Vetrana, at the upper part of which took place the prolonged eruption which lasted from 1895 to 1898, and which built up a considerable hill, the Colle Umberto I°. Photographs of this place, taken in 1888, showed the scoriaceous or cindery lava of 1872, coulées of slaggy or ropy lava in 1898, a moving mass of scoriaceous lava and the growing cone in the same year, while a photograph of the latter, taken at night by the light of the incandescent lava streams themselves, excited much interest, and it was followed by another showing the same cone in 1906 covered, and its surface obscured, by a thick coating of ash from the last eruption.

In the Strombolian type of eruption the explosion takes place from more or less liquid lava, of which portions are hurled into the air, and by their rotation often assume pointed or even globular forms, which are permanently preserved by the solidification of the mass while in the air. In the Vulcanian type, the materials, which are affected by the explosion, being already solidified, the ejecta are chiefly fragmentary, varying from dust of microscopic fineness to "bread crust bombs" weighing several tons. The latter owe their name to the characteristic crackings on the surface caused by the contraction of the crust when suddenly projected into the cold air, perhaps aided in some cases by the expansion of gases set free in the interior owing to the sudden reduction of pressure.

FIG. 2.—Vesuvius. Ash slide carrying away Cook's Railway. April, 1906.

[1] Substance of a discourse delivered before the British Association at York on Friday evening, August 3, by Dr. Tempest Anderson.

The Pelean type goes a stage further. In it a large proportion of the eruptive magma is blown to fine powder by the expansion of the gases it contains, and thus a mixture is produced of volcanic gases and incandescent dust in which each particle is surrounded and cushioned by an extremely thin layer of gas at a very high temperature, and therefore excessively mobile. The whole mass is therefore endowed with the mobility of a liquid, and under the influence of gravity rolls down slopes on which ordinary solids would lodge. This explanation of the hot blast which destroyed St. Pierre was first advanced by Dr. Flett and the lecturer in 1902, after witnessing an eruption of Mont Pelée, and it has since been generally adopted.[1]

In that year the Wallibu Valley at the foot of the Soufrière, in St. Vincent, was filled by such an incandescent avalanche to a depth of 80 feet, and the Rabaka Valley to a still greater depth. The torrential tropical rains, descending these valleys after the eruption, came in contact with this hot ash and caused various secondary phenomena, such as steam explosions, falls of ash, and gushes of boiling mud, which the lecturer compared with analogous, though somewhat different, phenomena during the late eruption of Vesuvius.

This eruption, as is usual with those of Vesuvius, presented features both of the explosive and effluxive types, *i.e.* explosions took place from the central crater, while a great fissure traversed the cone from north to south, and lava was discharged both to the north into the Atrio del Cavallo and also from, chiefly, three or four more *bocce*, or mouths, along the fissure to the south, which descended in the direction of Bosco Reale, Bosco Trecase, and Torre Annunziata.

The chief interest of the eruption of Vesuvius, however, undoubtedly centred round the explosions, the ejecta, and the secondary phenomena in connection with them. The volcano was in unusual activity in April and May, 1905, and had never been absolutely quiet since that time. From April 4 to April 8, 1906, and to a less degree later, a series of explosions took place which enlarged the great central crater to an average diameter of more than a quarter of a mile (as measured by Prof. Loczy), removed the highest central part of the cone, and thus reduced the height of the volcano by about 350 feet, as measured barometrically by the lecturer's party. The resulting débris was distributed in part over the flanks of the cone, while a larger amount of smaller material was carried to the other side of Somma as far as Ottajano and San Giuseppe. In these villages it attained a depth of 3 feet to 4 feet, and broke down the roofs of many houses, and more than one church. In that of Giuseppe, about 250 persons, who had taken refuge, were buried by the débris and met their death. The crater as seen by the lecturer's party on two ascents was oval or heart-shaped, the longer diameter being north and south, the walls sloping somewhat at the top, while lower down they were precipitous, especially towards the south side. At the north side the slopes were somewhat more gentle and the crater wider, while the lip was much lower, and broken down into a sort of plain some yards wide. This section of the crater corresponds exactly with a diagram in a report by the Academy of Sciences of Naples on the eruption of 1737. This eruption seems to have been very similar to that of the present year, and, as in this case, several persons lost their lives at Ottajano. There can be little doubt that the projection of fragmentary material in the direction of Ottajano was in both cases principally due to the shape of the crater when thus, so to speak, re-excavated. A contributing effect was the south-west wind, which blew so strongly as to carry some of the finer material as far as Nola. The wind's effect was to be clearly seen in Naples, where several inches of dust were deposited.

The larger ejected blocks fell chiefly during the earlier part of the eruption on the slopes of the cone and round its foot, where they were mingled, and to a large extent covered up, with much ashes and scoriæ. Here were to be seen the most interesting phenomena of the eruption, viz. the great ash slides. The cone was previously almost smooth and very regular in outline. It consisted of lava streams and dark-coloured ash; in April, 1906, it was thickly covered with whitish ash. This, when it attained a certain thickness, peeled off in veritable avalanches and slid down the mountain. The tracks present a radial appearance, and did so before any rain had fallen. It seems likely that the well-known umbrella-like markings on volcanic cones of tuff (consolidated ash), which have usually been attributed solely to erosion by rain, may in some cases, at any rate, be due to this cause. The avalanches were of sufficient power to carry away the Cook Railway. In one part below the funicular station the rails were bent like wire, and remained for a hundred yards or more along the sides of the avalanche track at right angles to their former position. They were kept together by their fish-plates, but had been entirely stripped of the sleepers. No stratification or particular structure in the materials brought down was noticed. A look out was kept for Lava del Fango (mud lava), which has often caused much damage after Vesuvian eruptions, but there had been no rain to form it before the lecturer's arrival, and comparatively little fell during his visit, so that only very small flows were seen. Prof. Lacroix, however, was fortunate enough to observe a large stream of mud above Ottajano, and he remarked that the resulting breccia was a little harder than the result of the dry avalanches, but presented no particular stratification or other structure by which it could be distinguished from the products of a dry avalanche of the same materials. Consequently no light is thereby thrown on the question whether many tuffs, such, for instance, as those which entomb Pompeii, were deposited, dry or wet.

The lava of this eruption also deserves mention. Flows occurred from the north and south ends of the fissure through the cone above mentioned. That to the north flowed into the Atrio del Cavallo in the early part of the eruption. It was soon covered up with fragmentary ejecta, and at the time of the visit only a few fumaroles remained to mark the course of the fissure. On the south side of the cone three or four *bocce*, or mouths, opened along the fissure, the streams coalesced, and the lava flowed thus for more than half a mile. It then divided into branches, which to a large extent destroyed the villages of Bosco Trecase and Bosco Reale, and nearly reached Torre Annunziata. It crossed and filled up a cutting on the Circumvesuvian Railway.

The discourse concluded with a number of photographs of explosions from the crater taken by the lecturer during his stay of five nights at Cook's Eremo Hotel, near the observatory.

[1] See Anderson and Flett, Phil. Trans., series A, vol. c., p. 353 *et seq.* (1903); also Anderson, *Geographical Journal*, March, 1903.

THE ASCENT OF RUWENZORI.

MR. DOUGLAS W. FRESHFIELD gives in the *Times* of September 13 some authentic details of the success of the Duke of the Abruzzi's expedition to Ruwenzori, from a letter received by him from Signor Vittorio Sella, who accompanied the expedition. Signor Sella wrote to Mr. Freshfield under date July 22, from Fort Portal:—

"His Royal Highness, accompanied by two Courmayeur guides, climbed all the five highest snowy peaks of Ruwenzori and took from them observations with a mercurial barometer besides a great many bearings with a prismatic compass. Captain Cagni carefully measured a base-line near Bujongolo in order to ascertain the exact distance between the highest peak of Kiyanja (which he climbed) and the rockshelter Kichuchu. His Royal Highness will therefore be able to publish a really good and complete sketch map of the snowy portion of the chain. Following in his Royal Highness's footsteps I ascended several high peaks and took many photographs and panoramas. I also secured many pictures in the forests and valleys of Mubuku and Bugiogo (the largest tributary of the Mubuku), and some telephotographs of the chain from near Butiti. The weather, however, was very trying to our patience. From June 12 to July 7 we had not a single really fine day.

"His Royal Highness from his barometric observations will soon be able to calculate and give the correct heights of the crowning peaks of Ruwenzori, which are several

hundred feet higher than Kiyanja and situated north-west of it. They have no connection with the Mubuku Glacier."

Mr. Freshfield finds that a rough sketch plan of the snowy group, sent by Signor Sella, coincides closely with the diagram of Lieut. Behrens, R.E., published in the *Geographical Journal* for July last, and concludes that "there seems little doubt that the highest summits measured by our engineers are identical with the Duke of the Abruzzi's Ruwenzori." Hence the height of the Ruwenzori range may be taken as 16,625 feet.

The chief topographical discovery made by the Italian expedition, apart from its mountaineering successes, seems to be that the northern fork of the Mubuku, called by Signor Sella the Bugiogo, is of hitherto unsuspected importance. Its stream flows round a bend, which conceals its sources from the lower valley. Beyond this lies a basin penetrating far into the heart of the chain, at the head of which, and on the actual watershed, the highest peaks stand.

THE TORONTO MEETING OF THE BRITISH MEDICAL ASSOCIATION.

THE annual meeting of the British Medical Association, held on August 21–25 at Toronto by invitation of the Canadian Branch, under the presidency of Dr. Reeve, the dean of the medical faculty of the university, was a marked success. The city is a fine one, and the university buildings in the Queen's Park are admirably adapted for the work of a congress, combining convenience and beautiful surroundings. About 1600 members and visitors attended, the British contingent numbering 200 or thereabouts. Canadian hospitality was lavish, and we all carry back pleasant memories of our visit to this great country. In addition, good work was done, and the attendance at the numerous sections was well maintained.

A combined meeting of the sections of physiology and pathology discussed the pathology and physiology of the cell nucleus. The discussion was opened by Prof. Adami, of McGill, in a paper giving an excellent survey of the subject. The conclusions formulated were that (1) the nuclear matter conveys and determines, or controls, the inherited peculiarities of the individual, this conveyance being through matter contained in the chromatin loops or chromosomes, while it may be that these individual loops, varying among themselves, determine particular conditions; (2) the nucleus is essential, not merely for the vegetative activities, but also for the higher metabolic activities of the cell and their due coordination; (3) the nucleus is not merely the vegetative centre of the cell, but is involved in its functional activities; (4) the higher syntheses, those associated with growth and those governing specific cellular enzyme actions, are determined and initiated by the nuclear matter; (5) the nucleus is the centre or source of the higher cellular activities, and the nuclear material possesses in itself potentialities superior to those of any ordinary constituent of the cell body; (6) the presence of preformed cytoplasm is essential for the continued existence and growth of the nucleus—each becomes essential for the continued existence of the cell as a whole.

Dr. Ford (Johns Hopkins University) read a paper on an antitoxin for poisonous fungi. He concluded that the toxic agent of the *amonita* was of the nature of a glucoside, and that an antitoxic serum could be prepared with it. It was pointed out in the discussion that this idea was somewhat revolutionary, as hitherto it had been impossible to obtain with glucosides an antitoxic substance.

Several papers were read on cancer. Dr. Clowes (Buffalo) had found that in experimental cancer in mice spontaneous recovery often occurred, and that such animals are immune to further inoculation. This was confirmed by Dr. Bashford (London), who stated that there is no evidence that cancer is on the increase, nor that it is endemic in districts. He had never obtained any transference by mere contact, *i.e.* cancer is not contagious. Prof. Gaylord (Buffalo) detailed some remarkable instances which seemed to show that certain malignant tumours in rats and mice are contagious. As a result of the discussions on cancer, it is noteworthy that the parasitic theory of the origin of cancer seems almost to have been abandoned by pathologists.

Prof. Hewlett and Dr. de Korté (London) read a paper on a beri-beri-like disease occurring in monkeys. The facts observed suggested that beri-beri is an infective disease due to a protozoan parasite, and conveyed by urinary infection. Dr. Ruffer (Egypt) detailed observations on the occurrence of organisms indistinguishable from the cholera vibrio in persons who had not been in contact with cholera.

Prof. Woodhead (Cambridge) stated that he had found opsonins in varying quantity in different milks, facts suggestive of certain lines with regard to treatment.

A combined discussion between the sections of physiology and medicine on over-nutrition and under-nutrition, with special reference to proteid metabolism, was opened by Prof. Chittenden (Yale). As is well known, Prof. Chittenden suggests that half the proteid usually regarded as necessary to support physiological equilibrium is all that is required. Prof. Halliburton (London) did not think that the experiments were conclusive, and suggested that the minimum diet of Prof. Chittenden did not leave any margin for that "reserve force" so necessary to ward off attacks of disease. It might be that in the excess of proteid beyond that required to maintain physiological equilibrium there might be traces of substances which yielded this reserve force. Dr. Robert Hutchison (London) considered that the proteid question could only be solved by cooperation between physiologists and physicians. We wanted to know, not the proteid minimum, but the proteid optimum. There was a danger in sailing too near the wind; we could get along with one lung or one kidney, but two of either organ were preferable. High feeding is responsible for cure in tuberculosis and neurasthenia.

The address in surgery was delivered by Sir Victor Horsley, who took as his subject the technique of operations on the central nervous system. He showed how, by means of Prof. Vernon Harcourt's inhaler, chloroform could be administered in known amount up to 2 per cent., that during some period of the operation the amount of chloroform could be reduced to 0·5 per cent., and that the administration of oxygen stopped venous oozing.

The Senate of Toronto University conferred the honorary degree of LL.D. on, among others, Sir W. Broadbent, Bart., Sir Thomas Barlow, Bart., Sir James Barr, Sir Victor Horsley, Prof. Clifford Allbutt, Prof. Halliburton, Dr. Donald Macalister, and Prof. Aschoff, of Freiburg.

R. T. HEWLETT.

A LARCH SAWFLY IN CUMBERLAND.

THE Board of Agriculture and Fisheries recently directed attention in the Press and its journal to the attack of the sawfly (*Nematus erichsoni*, Hartmann) upon larches. So far, serious damage has only been reported to the Board from Cumberland, where the health, if not the life, of an extensive plantation is said to be in danger. This insect is commoner than is supposed, but does not, as a rule, occur in large numbers in this country. There are very few collectors of these insects, hence we are apt to look upon species as rare which really have a wide distribution.

Cameron, in his work on British "Phytophagous Hymenoptera" (vol. ii., p. 51, 1885), only records the insect from an unknown locality. Dale mentions it as occurring at Glanvilles Wootton. It has also been seen on larches near Esher, at Wye, Great Staughton, and Budleigh Salterton. It is widely distributed over Europe, where it is now and then sufficiently abundant to become harmful, especially in Germany. Hagen also records it from the United States.

The adult sawfly has a black thorax, the abdomen red, with the basal seventh and ninth segments black. The legs are dull reddish, with most of the tibiæ white, and the posterior feet and apex of the femora black. In length it is about half an inch. The male has not, apparently, been described.

The larvæ are nearly three-quarters of an inch long when mature, and feed upon the leaves from the *beginning* of July to the end of August. In colour they are shiny grey or dark grey, with the back darker grey except on the second segment. The skin is covered with short, black

tubercles, and the spiracles show as brown spots. The legs are spotted with black, and the head is shiny black.

When mature the larvæ fall to the ground and spin their cocoons amongst moss, grass, &c., beneath the trees. The cocoons are more or less cylindrical in form and brown in colour. Many may occur close together. Fortunately these larvæ are preyed upon by several hymenopterous parasites. It is probably these that cause its sudden disappearance in localities where it has occurred. It is, nevertheless, as the Board of Agriculture advises, "of the utmost importance that outbreaks should be discovered at an early stage so that they may be suppressed while still of restricted extent"—an axiom that applies to all insects and fungi that are likely to cause harm to man's crops, trees, or stock.

The Board is preparing an illustrated account of this insect, which will be published in the October issue of its journal. Many such isolated outbreaks of insect pests of greater importance might with advantage be treated in a similar manner. F. V. T.

SOME RECENT PALÆONTOLOGICAL PAPERS.

DURING the wide range of field-observation covered by the Austrian Geological Survey, numerous new localities for fossils come to light, while the collections brought to Vienna from outside the Empire furnish the members of the Reichsanstalt with rich material for comparison. R. J. Schubert (*Jahrbuch der k.k. geol. Reichsanstalt*, 1905, p. 613) has continued his comprehensive research on the otoliths of fishes, which is finely illustrated with photographic plates. In the *Verhandlungen* of the same body (1906, p. 124) he summarises his results, which are shown to have a bearing on the geographical conditions of Miocene and Pliocene times in Europe. For instance, in accordance with what we know of the Congeria-beds, the otoliths in these strata are found to belong to the Sciænidæ, a family haunting especially the mouths of large rivers, and even penetrating into fresh water.

Franz Toula (*Jahrbuch der Reichsanstalt*, 1905, p. 51) also throws new light on the Congeria-beds of Vienna by describing Pelamycybium, a new genus of fish, which has been discovered in them. He discusses a wide range of literature on allied forms of tunny. In the current volume for 1906, p. 1, O. Abel investigates the fishes with greatly developed fins that have been recorded from various formations, and states that the Triassic genera Thoracopterus, Bronn., Gigantopterus, and Dollopterus are the only ones that can be referred with certainty to the flying-fish. The two last-named genera are new to science. All these fossil forms are constructed outwardly on the type of the modern Exocœtus. The species of Chirothrix with large fins, and other members of Smith Woodward's Chirothricidæ, are believed by Abel to have been incapable of flight. It is hard, moreover, to have to note that a species known as *Engraulis evolans* is similarly rejected. Zoologists will be interested in the general discussion of the flight of fishes and its origin (pp. 55–84), and the comparison between true flying-fish and others with expanded pectoral or ventral fins. The author, to avoid misconception, would prefer to speak of "parachute-fish" rather than of "flying-fish." There is no indication that any fossil example used its pectoral fins more effectively for flight than is the case in modern times. The memoir is fully illustrated; and the realisation of flying-fish gleaming in the Triassic sunlight adds a new fascination to the ancient European sea.

G. Stache (*Verhandlungen, ibid.*, 1905, p. 292) directs the attention of zoologists as well as palæontologists to his Sontiochelys, a new chelonian from the Cretaceous of Görz, the affinities of which are with living forms in Australia and Brazil, rather than with fossil Jurassic forms in Europe.

O. Abel (*Jahrbuch, ibid.*, 1905, p. 375) has described a cetacean, *Palaeophocaena andrussovi*, from the Middle Miocene of the Taman peninsula in the Black Sea. This early form has led him to examine the living Phocæna of the Black Sea, and to assign to it the specific name *relicta*. The author points out the differences between it and *Ph. communis*, and urges that it arose in the Black Sea area as a direct descendant of the Miocene type. Phocæna is absent from the Mediterranean, while the two dolphins found with it in the Black Sea, *Tursiops tursio* and *Delphinus delphis*, abound there, and Herr Abel is thus supplied with additional grounds for his contention. He also describes (p. 393) a Miocene transitional form between Halitherium and Metaxytherium.

Passing to the primates, we note that Prof. Rzehak (*Verhandlungen, ibid.*, 1905, p. 329) gives a preliminary account of a lower jaw belonging to a being of the Spy and Krapina type, from Ochos, near Brünn in Moravia. Every addition to our knowledge of this early type of man in Europe, Wilser's *Homo primigenius*, is to be welcomed, especially as it seems not so long ago when the Neanderthal calvarium was the sole representative of the race. The features shown by the lower jaw of a child found in a cave at Shipka, and hitherto regarded as exceptional, are interestingly repeated in that of the adult from the Ochos cave.

T. Fuchs (*ibid.*, p. 198) defends the organic character of the honeycomb-markings known as Palæodictyon, in opposition to the views of Capeder in 1904, who reproduced artificially a fairly similar structure.

Prof. Yokoyama sends a paper on Mesozoic plants from Nagato and Bitchu (Journal of the College of Science, Imperial University, Tokyo), illustrated by three beautifully executed plates. The work confirms the author's previously expressed opinion that a Rhætic flora occurs at Yamanoi.

Part iii. of vol. xxxii. of the Records of the Geological Survey of India is mainly concerned with palæontology. Prof. Diener, of Vienna, describes the permo-Carboniferous fauna of the Subansiri valley in Assam, adopting Waagen's term "Anthracolithic" for beds of the two systems considered jointly. Mr. G. E. Pilgrim reviews the distribution of *Elephas antiquus*, which he regards as having originated in the Pliocene of Europe, reaching India somewhat later in geological time, as glacial conditions set in across Europe. In neither area, however (p. 218), did it leave any direct descendants. The paper is accompanied by five handsome plates. Prof. Diener, in a second paper, points out that a bed of Triassic limestone in Byans, 3 feet thick, represents the Noric and Carnic faunas, the forms from distinct horizons becoming mixed in so small a thickness of sediment.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PROF. WILHELM WIEN, professor of physics in the University of Berlin, has been invited to occupy the physics chair in the University of Berlin, in succession to the late Prof. Drude.

Science states that by the will of the late Mr. T. Kearney, of Freno, his entire estate, amounting to about 200,000l., is bequeathed to the department of agriculture of the University of California.

THE authorities of the Leland Stanford University, which suffered severely through the San Francisco earthquake, are reported to have decided to sell the jewels of Mrs. Leland Stanford, bequeathed to them by their late owner, for the purpose of restoring the University library; the value of the jewels is estimated at a million dollars.

BIRKBECK COLLEGE will commence its eighty-fourth session on Wednesday, September 26, when Sir Edward H. Busk, Vice-Chancellor of the University of London, will give the opening address. The college has added considerably to its appliances in recent years, and the physical, chemical, biological, and metallurgical laboratories are well equipped. Courses in mining, metallurgy, and assaying are given both in the day and evening.

THE council of University College, Bristol, has offered the chair of chemistry, just vacated by Dr. Travers, F.R.S., to Dr. Francis Francis. Dr. Francis studied at

University College, Liverpool (now the University), and at Erlangen, and has been assistant professor at University College, Bristol, since 1903. He has published many papers in journals of chemical societies, both in England and Germany, among his most recent papers being one on benzoyl nitrate, which describes a new method for the nitration of organic compounds.

THE annual report of the South Australian School of Mines and Industries for 1905 shows that excellent progress in technical education is being made at Adelaide. The number of students enrolled was 1507, and the number of subjects taught was forty-five, courses having been started during the year in agriculture, building drawing, dairy work, motor management, veterinary science, and flower culture. The report contains a detailed account of the laying of the foundation-stone of the new metallurgical building on October 3, 1905.

FROM among recently made foreign appointments we note the following:—Dr. Emil Bose, lecturer in physics of Göttingen University, to be professor of physical chemistry in the Danzig Technical High School; Dr. Alfred Kalähne, of Heidelberg University, to the physics chair of the same institution; Dr. Taddäus Godlewski to be extraordinary professor of general and technical physics in the Technical High School, Lemberg; Dr. K. Fries to be a departmental director of the chemical institute of Marburg University in succession to Prof. R. Schenck, who has received an appointment in Aachen; Dr. Franz Waterstradt, scientific assistant to the German Agricultural Society, to be extraordinary professor in the University of Breslau; the lecture courses on inorganic and analytical chemistry of the Faculté des Sciences of Paris University, which Prof. Ribau is giving up on his retirement from active academic life, have been deputed to MM. Paul Lebeau and G. Urbain, while M. L. Ouvrard has been appointed director des laboratoire d'enseignement et de recherches chimiques of the same faculty.

THE new laboratory of physical and electrochemistry which has been presented to the University of Liverpool by Mr. E. K. Muspratt will be formally opened on Saturday, October 13, by Sir William Ramsay, K.C.B., F.R.S. Besides many eminent English chemists, the following distinguished foreign men of science have accepted invitations to be present:—Profs. Ostwald (Leipzig), Abegg (Breslau), Cohen (Utrecht), Goldschmidt (Christiania); also Prof. Lash Miller (Toronto). Addresses will be delivered by Sir William Ramsay and Prof. Ostwald. The distinguished guests will be entertained to dinner by the University Association on October 12, and by the Liverpool section of the Society of Chemical Industry on October 13. The new laboratory contains twenty-one rooms, and has been specially built and fitted for work in physical and electrochemistry. Its electrical equipment includes an 80-kilowatt motor alternator, a 30-kilowatt motor generator for direct current, a 10-kilowatt charging set (all by Messrs. Siemens Bros.), and a 36-cell Tudor accumulator battery. The name of the new laboratory is to be "The Muspratt Laboratory of Physical and Electrochemistry."

ON Wednesday, October 3, Sir William Ramsay, K.C.B., will give a public lecture at University College, London, on "The Chemical Nature of Electricity," and on October 4 Prof. L. W. Lyde will give an introductory lecture on "Geography as a 'Corollating' Subject in School Work." These two lectures are open to the public without payment or ticket. Among the courses of free lectures shortly to be commenced at the college are the following:—Six lectures, open to the public without payment or ticket, on the "History of Statistics and the Nature and Aims of Modern Statistical Methods," by Mr. G. U. Yule, on Wednesdays at 5.30, commencing Wednesday, October 10; ten lectures on "Recent Development in the Teaching of Arithmetic and Elementary Mathematics," by Mr. F. L. Grant, on Saturday mornings at 10 a.m., beginning on Saturday, October 13; ten lectures on "The Hygienic Needs of the Scholar," by Prof. Henry Kenwood, on Thursday evenings at 7.30 p.m., beginning on Thursday, October 11. This course and that on mathematics are open, without fee, to all teachers in London schools. Teachers wishing to attend should apply for forms to the Executive Officer, London County Council Education Offices, Victoria Embankment, W.C. Forms must be returned not later than Saturday, September 22.

SPEAKING at Hawarden on Monday on the objects and advantages of education, Mr. Wyndham remarked that "it was right to include science in the curriculum because we are now living in an age of science. In the sixteenth century people lived in an age of literature, and the minds of men were attracted toward the old books written in Greek and Latin." This difference between the needs of the two ages was pointed out by Sir Norman Lockyer in an address at the Borough Polytechnic Institute last December, printed in NATURE of March 29 (vol. lxxiii., p. 521), as the following extract from the address clearly shows:—"We must arrange our education in some way in relation to the crying needs of the time. The least little dip into the history of the old universities will prick the bubble of classical education as it is presented to us to-day. Latin was not learned because it had the most magnificent grammar of known languages. Greek was not learned in consequence of the transcendental sublimity of ancient Greek civilisation. Both these things were learned because people had to learn them to get their daily bread, either as theologians or doctors or lawyers, and while they learned them the 'nature of things' was not forgotten. Now what is the problem of to-day? We are in a world which has been entirely changed by the advent of modern science, modern nations, and modern industries, and it is therefore perfectly obvious that if we wish to do the best for our education it must be in some relation to those three great changes which have come on the world since the old days."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 31.—"On the Main Source of 'Precipitable' Substance and on the *Rôle* of the Homologous Proteid in Precipitin Reactions." By Prof. D. A. **Welsh** and Dr. H. G. **Chapman**. Communicated by Dr. C. J. Martin, F.R.S.

Conclusions.—(1) The homologous proteid is not wholly removed from the superfluid of a precipitin interaction, whether it is more than sufficient or less than sufficient to neutralise all the precipitin present.

(2) Conclusive evidence that the homologous proteid is sensibly diminished in similar circumstances has not been obtained.

(3) The substance that is thrown out of solution is derived mainly from the anti-serum.

(4) The character of an anti-serum depends upon two factors which are mutually independent, (*a*) the precipitable content, (*b*) its precipitability.

(5) The precipitable content is indicated by the maximum precipitum obtainable from a given amount of the anti-serum.

(6) Its precipitability is indicated by the minimum amount of homologous proteid that will completely neutralise the precipitin in a given amount of the anti-serum.

(7) The solid content of precipitin anti-sera is increased relatively to that of natural sera.

June 28.—"On the 'Kew' Scale of Temperature and its Relation to the International Hydrogen Scale." By Dr. J. A. **Harker**.

In 1887 the International Committee of Weights and Measures adopted as the standard thermometric scale the *constant-volume hydrogen thermometer*. By far the majority of temperature measurements are made by means of mercury thermometers. The ideal mercury thermometer would be one which, when subjected to any steady temperature, would assume immediately a steady reading identical with that given by the hydrogen thermometer at the same temperature. This ideal is, as might be expected, not attained by any known mercury-in-glass thermometer, and the amount of the departure from the ideal at different

temperatures depends on the particular kind of glass employed.

For many years thermometers have been verified at Kew Observatory in large numbers annually, their indications being referred to the *Kew Scale* of temperature. It has recently become a matter of interest to determine to what degree of accuracy the *Kew Scale* may be considered as identical with that of the hydrogen thermometer, and this memoir gives an account of some experiments undertaken at the National Physical Laboratory with a view to elucidate this question.

The usual type of Kew standard thermometer is an instrument having a range from below 32° to above 212° F., and is usually divided only to 1° F.

For the purpose of this research it was thought desirable, after studying the behaviour of a number of these old thermometers, to construct new standards, having a more open scale and capable of being read to higher accuracy, and to treat these from the beginning in a definite and systematic manner.

The readings of a Kew standard are always understood to apply to the thermometer in a vertical position when immersed in water up to the reading, and the instruments are always intended to be used as "fixed" rather than as "movable zero" instruments. That is, the normal procedure to measure any temperature on the Kew scale would be *first* to determine the zero and *afterwards* the temperature in question, applying to the latter a constant correction for any deviation of the zero point from its nominal correct value, 0° C. or 32° F., and ignoring all subsequent zero changes.

The main conclusions of the work are:—

(1) The departure of the natural scale of the "Kew" mercury-in-glass thermometer from the international hydrogen scale is very small at all temperatures.

(2) For measurement of temperature *differences* over ordinary ranges, such as in calorimetry, the results obtained directly or indirectly from a Kew standard may be considered as hydrogen temperatures without application of any correction.

(3) In some instances when defining the temperature at which certain standards have their definite value, such as, for example, the temperature 62° F. for the British standard yard, the temperature scale to which the measurement referred was not definitely specified. This research renders it probable that if the instrument were a good English glass thermometer approximating to a Kew standard, the error made in considering its indications as identical with the hydrogen scale would be within the limits of accuracy of length measurements.

(4) For the ordinary ranges of meteorological and clinical thermometers reading to 0°·1 F., many thousands of which have been verified at Kew annually for many years past, the temperatures as given on the Kew certificate may be considered as hydrogen temperatures.

(5) The table appended gives the mean departure from the hydrogen scale of the "Kew" scale of temperature as observed in this investigation, the figures being rounded to the most probable 0°·005 C. For comparison purposes the figures for French "Verre Dur" and for "Jena Glass 16^{III}" are added in parallel columns, it being understood that each glass is treated in the manner prescribed for it, the Kew glass being a "fixed zero" scale and the other two "movable zero."

Differences in Degrees Centigrade.

	Kew glass. $T_{Kew}-T_{Hyd.}$	Verre dur. $T_{VD}-T_{Hyd.}$	Jena glass. $T_{16^{III}}-T_{Hyd.}$
0	+0·000	+0·000	+0·000
10	+0·000	+0·052	+0·056
20	+0·000	+0·085	+0·093
30	−0·005	+0·102	+0·113
40	−0·010	+0·107	+0·120
50	−0·010	+0·103	+0·116
60	−0·010	+0·090	+0·103
70	−0·015	+0·072	+0·083
80	−0·020	+0·050	+0·058
90	−0·025	+0·026	+0·030
100	−0·000	+0·000	+0·000

PARIS.

Academy of Sciences, September 10.—M. A. Chauveau in the chair.—Variations in the gravitation constant in the Simplon Tunnel: Marcel **Brillouin.** A *résumé* of the various corrections required by the crude readings of the instrument used. The complete work will be published in the *Recueil des Savants étrangers.*—The experiments of M. Villard and his theory of the aurora borealis: Carl **Störmer.** In his memoir published in 1904 on the motion of a material point carrying a charge of electricity, and continued in two recent notes in the *Comptes rendus*, the author has developed a theory which not only explains the phenomena experimentally observed by M. Villard, but also predicts others not yet observed, and renders doubtful certain of M. Villard's conclusions regarding the aurora borealis. The experiment of M. Villard, in which the magnetic field is due to two equal and opposite magnetic poles, is considered in detail in the present note, and the trajectories worked out for several cases, diagrams being given. The author draws the conclusion that Birkeland's theory is not shaken by M. Villard's paper.—The atomic weight of silver: P. A. **Guye** and G. **Ter-Gazarain.** Reasons are given for showing that the atomic weight of silver should be lowered from 107·93 to 107·89.—A case of formation of anthocyanine under the influence of the puncture of an insect (*Eurrhipara urticata*): Marcel **Mirando.**

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